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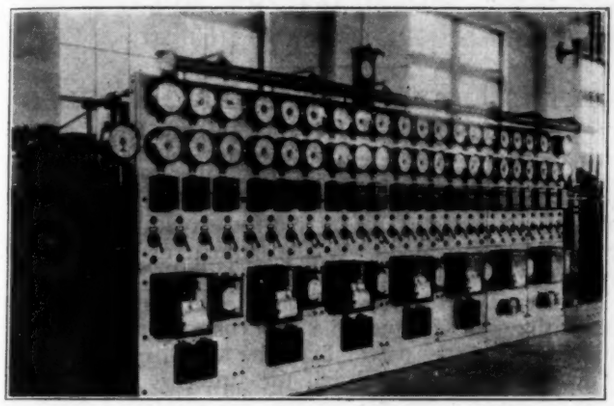
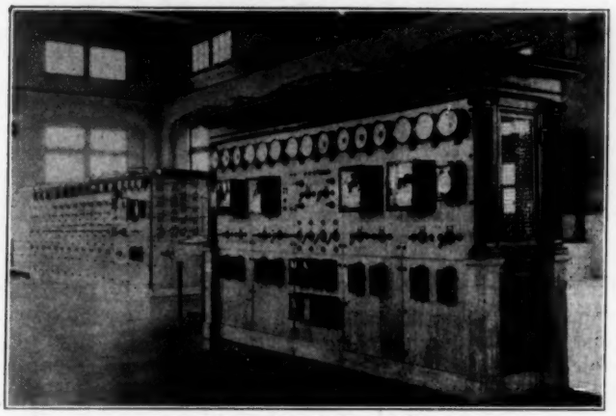


Seven-Panel Feeder Switchboard Installed in Nisqually Substation, Tacoma, Wash.



Five-Panel Switchboard Controlling High-Tension Lines and Transformers—14-Panel Board in Background.

Some Features of the Nisqually Substation at Tacoma, Wash.

Switchboard and Control Equipment—Interesting Method of Regulating the Standby Battery for Operating Circuit-Breakers and Pilot Lamps

THE supply of electrical energy for the city of Tacoma, Wash., is well provided for by the Nisqually substation of the Department of Light and Water of that municipality. The station was designed to transform and distribute electrical energy up to a capacity of 20,000 kw. Three-phase, 60-cycle power is received at 50,000 volts over two transmission lines from the city's hydroelectric station at La Grande, 36 miles distant.

A tap is taken off the high-tension line to supply Camp Lewis and also the pumping station for the city water supply. Current is distributed at 4000-2300 volts, over a Y-connected primary distribution system throughout the city for light and power. By agreement with the city, the private central-station company operating in Tacoma does not furnish any light or any power in units under 25 hp. within the city limits.

Though the substation was originally designed for a capacity of 20,000 kw., it usually carries a load of 24,000 kw. or over. The substation is under the direction of F. S. Morrison, chief operator, who has under him one operator and an assistant for each of the three 8-hour shifts.

For regulating the voltage of the light and power feeders, there are installed 21 69-kv-a., 10 to 20%, single-phase automatic feeder regulators.

The switchboards for the control of the incoming lines, outgoing feeders, series arc street-lighting circuits and auxilaries in the substation are built in sections and mounted separately, as shown in the accompanying illustrations. The boards are of blue Vermont marble surmounted by cornice work and are equipped with the usual complement of switching and measuring devices, making altogether a most attractive looking installation. Each outgoing feeder circuit is equipped with a graphic recording meter. The switchboards, together with the lightning arresters and oil circuit-breakers on the high-tension lines, transformer banks and feeder circuits, and the feeder regulators were furnished by the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.

Standby current for the operation of the remote-controlled circuit-breakers and the pilot lamps is furnished by a storage battery which floats on the line continuously. It contains 65 cells and is of the E-11 type supplied by the Electric Storage Battery Co., Philadelphia, Pa.

Current for normal operation of the circuit-breakers and pilot lamps and for charging the battery is supplied by a motor-generator installed in the basement. The battery is kept floating on the line continuously, that is, it is never discharged except in an emergency and during tests, and it is charged just enough to equalize the cells once every two weeks; at other times the motor-generator carries the load and the battery floats.

The floating voltage of the battery is from 2.10 to 2.14 volts per cell, and in order to protect the graphic meters and pilot lamps it was necessary to insert a resistance. The resistance originally used was a grid with a standard rheostat head which protected the

Two Three-Pole 60,000-Volt, 300-Ampere Oil Circuit-Breakers on Incoming Lines—Transformers in Background.

devices but did not allow enough current to pass to operate the oil circuit-breakers. In order to overcome this difficulty, counter cells were installed, some of which were built up out of old battery elements. These cells reduce the voltage, but at the same time permit a sufficient flow of current to operate the breakers. There are 12 counter cells divided into three groups of four each, with taps taken off so as to permit the cutting in or out of one or more groups as may be desired, and they are so connected that the current passes through them from positive to negative, thus continually charging them.

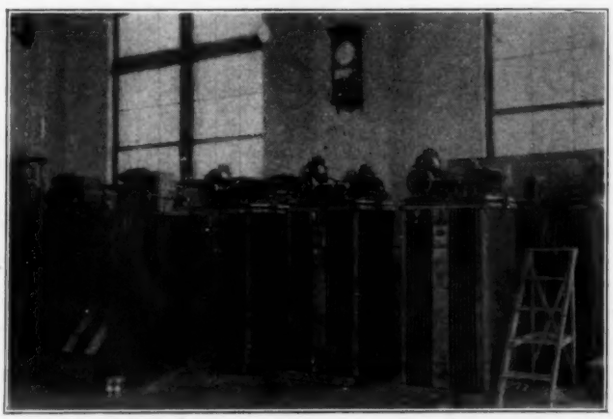
The operation of the graphic meters and pilot lamps requires a continuous flow of about seven amperes through the counter cells which causes a rapid evaporation of the water as well as the deterioration of positive plates. To overcome this, Mr. Morrison has adopted the following scheme which has worked out most successfully. A 6.6-ampere series burning incandescent lamp is connected across each group of four cells. This shunts six amperes away from the cells, reducing the current flowing therein to from one-half to three-fourths of an ampere and at the same time affords the benefit of the illumination given by the lamps which are located at certain points about the premises where it is needed. These locations are vital points and in the event of the power going off at night the illumination is of the greatest assistance to the station operator.

In operating one of the circuit-breakers, the current momentarily reaches a value of seven amperes, thus subjecting the lamps to an excess rush of current. In order to correct this Mr. Morrison expects to add three more cells, making a total of 15; he will divide them into three groups of five each and install a short piece of resistance wire in series with each lamp so as to hold down the current to six amperes. A snap switch is installed on each lamp so that when the battery is getting its equalizing charge the lamp can be cut out, causing the counter cells to build up to their highest voltage at the time when it is most needed.

Five 4000-Volt, 600-Ampere, Four-Pole Oil Switches on Light and Power Lines.

FERTILE FIELD FOR AMERICAN ELECTRICAL GOODS IN LATIN AMERICA.

A most promising future for American electrical goods exists in Argentina, Brazil and Uruguay, according to a report made to the Bureau of Foreign and Domestic Commerce, Department of Commerce, by Trade Commissioner Philip S. Smith. The use of electricity is widespread in all three countries. In Argentina and Uruguay the high cost of imported fuel and lack of water power limit the use of electricity to some extent, but in Brazil the immense amount of water power available makes the electrical field a peculiarly attractive one to manufacturers of electrical equipment. As this water power is found for the most part in the coastal section of the country, it will be available for industrial enterprises and for general lighting, heating and power purposes in the numerous cities of this section, which includes the greater part of the population of the country.



Part of the Bank of 21 Single-Phase, 2300-Volt Regulators on Light and Power Feeders.

American materials were not a very important factor in Argentina before the war but have become decidedly so since hostilities began, and the problem there is to maintain this advantage when the old competition returns. In Brazil, American electrical supplies have always been favored above all others, owing principally to the fact that the power plants in the large cities use American materials almost exclusively. Germany's share in the trade, however, was increasing steadily up to the time the war started, and since that time Japanese materials have appeared on the market, although not in large quantities.

The trade commissioner's report is a detailed guide published for the benefit of the American manufacturer who wants to make the most of his opportunities in Latin America. It is entitled "Electrical Goods in Argentina, Uruguay and Brazil," Special Agents Series No. 184.

Central-Station Rates in Theory and Practice

Eighteenth Article — Rates Based on Both Energy and Demand—Time Interval of Maximum Demand, How Demand Is Determined and Other Details—Power-Factor—Demand Measuring Instruments

By H. E. EISENMENGER

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This is the eighteenth article of this series that began in the issue of July 12. The first part of the series consisted of seven articles on the cost of central-station service. In Part II there were six articles on the policies relative to choice of a rate system. Part III, of which this is the fifth article, deals with the different rate systems in more or less common use; next week's article will conclude this part. In Parts IV to VI will be discussed rate analysis, accuracy of rates and rate regulation by commissions. The remaining articles will appear weekly until the end of the current volume, Dec. 27.

PART III—SYSTEMS OF CHARGING—Continued.

II. The Various Types of Rates—(Continued).

D. Rates Based on Both Energy Consumption and Demand.

2b. Details of the Determination of the Measured Demand in Practice.

1. Interval of Time Over Which the Customer's Demand Is to Be Averaged.

SECTION 134. As has just been shown, it is impossible to determine by exact theory how long the interval should be over which the customer's demand is to be averaged for the determination of his rated maximum demand. Consequently this interval in practice varies within very wide limits[1] and it is impossible to say that the time interval chosen by one company is more correct than that of another company as they all remain within reasonable limits. Here again is an instance where a wide field is left to the judgment of the designer of the rate. Where we have reason to assume that the customers of a certain class all have a peak of about the same duration it may be well to choose the duration of that peak as the interval over which the maximum demand is to be averaged.

Sometimes several intervals are quoted in the schedule as alternatives, so that smaller percentages are to be taken of the short-interval demands than of the long-interval ones.[2] Or shorter intervals are chosen for such loads as are subject to violent fluctuations, such as hoists, elevators, welding machines, etc.[3]

The instantaneous demand may also be made the basis for the rated demand, but then it is generally reduced by a certain large percentage to arrive at the rated maximum demand and special provisions may be made in that case to exclude the effects of short-circuits and accidents on the rated demand.[4]

2. Period Over Which a Certain Amount of Demand, Once Determined, Remains the Basis of the Charges.

135. As the capacity of the central station is determined by the yearly peak and the monthly peaks have nothing to do with it, it seems logical to take the customer's yearly maximum demand as the basis for all his demand during the whole year and not to change it until his peak load for the following year has been determined.[5]

In most cases it is felt, however, that a single high demand would penalize a customer for the whole year and thus might work hardship and injustice. The maxima are, therefore, taken usually for shorter periods than one year; most commonly the monthly maximum is chosen. As the bills are almost universally rendered monthly, the demand-meter reading can be easily taken together with the watt-hour-meter reading every month. We are trying in this manner to get a value which is proportional to the *probable* value of the customer's maximum demand as given by the character of his load and to eliminate the accidentals of a single maximum demand. Since the maximum demand is nothing but a substitute for the peak responsibility, it seems that the average of the 12 months' maximum demands is a good substitute for, or even a better one than, the amount which the demand happens to reach only once a year. If customer *A* reaches 50 kw. in one month and 25 kw. only during each one of the remaining 11 months, and if customer *B* reaches 40 kw. of maximum demand month after month, the 50-kw. maximum of *A* may

[1] 1 minute: Duluth, General Power, see footnote 2 below.
2 minutes: Buffalo, Wholesale Lighting and Power (optional schedule).
3 minutes: Binghamton, N. Y., Wholesale Power.
5 minutes: East St. Louis, Ill., Retail Power.
10 minutes: Waterbury, Conn., General Power.
15 minutes: City Electric Co., San Francisco. Wholesale Lighting and Power.
30 minutes: Chicago, General Lighting and Power.
1 hour: Detroit, Standard Power, where lighting amounts to more than 10% of total load.
3 hours: Detroit, Standard Power, where lighting amounts to less than 10% of total load.

[2] One of the two optional General Power Schedules of the Great Northern Power Co., Duluth, rates the demand at the option of the company as the highest of the following: 40% of the instantaneous peak, or half the maximum 1-minute peak, or two-thirds of the maximum 3-minute peak, or the maximum 5-minute peak.

[3] Primary Power, Cincinnati: 5 minutes instead of 20 minutes.

[4] The Duluth schedule mentioned in footnote 2 provides that peaks due to short-circuits and accidents shall not be counted.

[5] This would mean that the highest recorded demand of the previous 12 months is to be chosen, as in the Wholesale Light and Power schedule of Washington, D. C. A little different interpretation is made in the Standard Lighting schedule of Detroit, where the demand indicator is reset June 30 each year so that the customer has to pay for the maximum demand since the preceding June 30 only. In the first case the rated demand will never be smaller than the maximum of a full 12-month period, whereas in the second case the demand to be paid for will generally steadily increase from June until December and then remain stationary until June, when a sudden decrease to the June monthly maximum takes place.

be the result of some casual contingency (neglecting in this example, for the sake of simplicity, the seasonal regular variations of load) and *B* is then liable to have a larger peak responsibility than *A*; yet under a system which takes into account the yearly maximum demand *A* would have to pay more for demand charges than *B*.

The demand charges are mostly based simply on the monthly readings, but other plans for calculating the rated maximum demand are also found.[6]

3. *Sundry Details of the Determination of the Measured Demand.*

a. Influence of the Demands of Previous Billing Periods.

136. Various rate schedules provide that the rated demand depends on the previous demands of the same customer in such a manner that during the term of contract it may not decrease substantially below the highest demand established at a previous period[7], or that it cannot decrease below a certain percentage of the highest previous demand[8], or that the previous demand retains such a restricting influence at least for a certain length of time[9] (usually one year). In the latter case we get either the equivalent of a yearly demand, or if the maximum monthly demand may not exceed a certain percentage of the highest reading of the last 12 months, we arrive at a hybrid between the monthly and the yearly establishment of the demand.

b. Influence of the Power-Factor.[10]

137. A small number of electric supply companies make provision for a modification of the rated demand in case of the power-factor being below certain limits. Thus in some cases the demand is increased over the measured demand if the power-factor is smaller than a certain minimum percentage.[11] In other cases the regular demand charge of the schedule is not based on a 100% power-factor but on a smaller one; consequently the demand charge is not only increased for smaller power-factors but also decreased if the power-factor is large.[12]

Naturally provisions for an influence of the power-factor on the charges are found only in power rates for large consumers (wholesale power rates and general power as distinguished from retail power, etc.).

c. Methods Used for Measuring the Maximum Demand.

138. There are two methods in practical use for finding the maximum which the average demand over a certain interval (for instance 30 minutes) reaches within a given period (for instance, one year).

1. Determining the Demand by the Service Watt-Hour Meter.

139. The first method is the calculation of the average maximum demand from the number of kilowatt-hours consumed during the interval. The service watt-hour meter of the installation can be very conveniently used for that purpose in combination with a stop watch. If, for instance, the readings on the watt-hour meter show that during one certain hour 500 kw-hr. have been consumed, the average hourly demand during that particular hour is evidently 500 kw. If we now obtain a number of such readings at different hours when the maximum demand may be expected to take place, the maximum of these readings will be the nearer to the maximum average hourly demand the larger the number of readings has been. If we desire to know the average demand over a shorter (or longer) interval than an hour, we have to divide the kilowatt-hour reading of that interval by the length of that interval in hours.[13]

This method can, of course, be applied for large customers only and is not suitable for general use. It is not as reliable as the other method, to be described hereafter (special demand-indicating instruments) because it is left to chance whether the watt-hour-meter readings are made actually at that interval which shows the highest average demand. The test method is, therefore, not frequently used and where it is used

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[6] Standard Power schedule, Detroit, Mich.: The maximum demand is determined by load tests every 60 days.

Long-Hour Lighting schedule of Boston: The highest reading between Nov. 1 and Feb. 1 is taken to be in force for 12 months. That means a yearly maximum, but only that part of the yearly maximum demand is counted for which there is a possibility of its coinciding with the central station's peak.

The Retail Power schedule of the same city bases the demand charge on the average of the November-December-January-February peaks, whereas the demand charges of the Wholesale Power schedule are based on the average of the 150 highest half-hour peaks that have occurred in the 12 months previous to the bill.

The Primary Industrial Power and Railway Generating Power schedule of Baltimore requires that the demand be based on the highest readings (not less than ½ hour) between 4 and 8 p. m. any week-day during the months of November, December and January and not less than two-thirds of the actual demand at any other time.

The Wholesale Power schedule of the Sioux City Gas & Electric Co. rates the demand as the measured average over 15 consecutive minutes during the month, provided that the instantaneous demand is not more than twice the annual maximum demand. In the latter case the demand for the month shall be rated as 50% of the instantaneous demand.

The Large Lighting and Power schedule of Chicago provides that the demand be determined either monthly or yearly. When on the monthly basis, the average number of kilowatts in the highest 30-minute interval in the month is to be taken. When on the yearly basis the average number of kilowatts in the three highest 30-minute intervals in the month is selected from three different days, the first month's maximum to prevail for 12 months, unless a higher maximum takes its place, in which case a new 12-month period begins.

[7] Industrial Lighting and Power schedule of Baltimore, where the demand is not substantially to be decreased during the term of the contract. The minimum term of contract under this schedule is three years.

[8] Wholesale Power schedule of Macon, Ga., where the demand shall in no case be less than 75% of the highest previous recorded demand. Under the Primary Power schedule of Minneapolis the demand must never be under 50% of the highest previous peak occurring throughout the 10-year term.

[9] General Lighting and Power, Portland, Me.: Once determined, the demand may not be decreased during the year. Primary Lighting and Power schedule of Des Moines, Iowa: The demand shall not be less than 75% of the demand occurring in any of the preceding 12 months. Wholesale Power schedule of Pawtucket, R. I.: The demand shall never be under 50% of the highest in the preceding 12 months.

[10] The nontechnical central-station man will find an explanation of the term "power-factor" and allied terms in Insert XV.

[11] Primary Large Lighting and Power schedule, Chicago: If the power-factor is less than 70%, the maximum demand is increased for billing purposes. In other cities the limit of the power-factor is 80%, thus in Philadelphia (Wholesale Power Lighting), Harrisburg, Pa. (Primary Power), and Little Rock, Ark. (Wholesale Lighting and Power). In Pittsburgh (Off-Peak Service) the limit is 90%.

Another way of expressing the same thought is that of the Wholesale Power Schedules of Boston, which specify that either the average kilowatts, or 80% of the kilovolt-amperes, are used for the demand, whichever is higher.

The Wholesale Power schedule of the Sioux City Gas & Electric Co. specifies that the monthly demand charge will be increased by 1% for each 1% the lagging power-factor on the consumer's load is below the following:

75% at the time of the demand.
70% at 75% of demand.
65% at all other loads.

In Cambridge, Mass., the average demand during the peak-load period is determined from the kilowatt-hour consumption as indicated by a watt-hour meter in case of noninductive load and from the kilovolt-ampere-hours as determined by a voltmeter and and amperemeter in case of inductive load. (See Section 139, "Determining the Demand by the Service Watt-hour Meter" and second footnote of that Section.)

[12] The General Power schedules in the following New England cities: Waterbury, Conn., New Britain, Conn., and Salem, Mass., provide that the maximum demand be adjusted accordingly if the power-factor is below 75% or above 80%.

An extra discount of 10 cents per kilowatt per month is granted on the demand charge of the Sioux City rate (referred to in the preceding footnote) if the power factor is 95% or better.

[13] For instance, if in the 2 hours between 3 and 5 o'clock 100 kw-hr. have been used, the average demand during that interval has been $100/2 = 50$ kw. Or if in some 10-minute interval 8 kw-hr. have been used, the average demand during that interval has been $8 \div 1/6 = 48$ kw. (because 10 minutes equals 1/6 hour).

it is generally either as an alternative to some other method[14] or for secondary purposes.[15]

This method may also be carried out in a more accurate way by means of the so-called "printometer," that is an attachment to the customer's watt-hour meter which prints on a strip of paper in regular intervals—for instance, 5 minutes or half hours, etc.—the number of kilowatt-hours used.

2. Demand Metering Instruments.

140. The second method of determining the maximum demand makes use of special instruments for that purpose. This method is much more frequently employed than the calculation from watt-hour-meter readings and in all cases where the actual amount of the maximum demand in kilowatts or watts must be known the use of these instruments is the rule.

A description of the principles on which these instruments act is given in Insert XVI.

In a few cases the readings of the demand meter are modified by a stipulation in the schedule that the demand must never be taken lower than a certain percentage of the connected load.[16]

In some isolated cases the demand charge is based not on the measured demand, but on a certain fixed percentage of the demand.[17] This is, of course, merely a matter of changing the form; the total demand charge in dollars is the same as if the total measured demand had been chosen with a correspondingly reduced unit charge per kilowatt. But certain conditions, for instance the historical development of the rates of a company, may make this way of expressing the charges preferable.

The demand limiters (see Section 130) and similar devices, like fuses, automatic cutouts, etc.,[18] do not strictly belong in this class of instruments as they give no lasting record of the amount of the maximum demand, but they simply disturb the customer's supply as long as he tries to draw a larger demand than he has subscribed for. They have a very small time interval, which means that they act practically on the instantaneous demand.

d. Substitutes to Approximate the Measured Maximum Demand.

1. General Remarks.

141. Measurements of the maximum demand as described in the preceding Sections require either special labor, or special instruments, or both. Moreover, as has been pointed out several times in this series of articles, the element of the customer's demand as a basis for the demand charges has been derived from the theoretically correct basis by a series of approximations and therefore is not the accurate basis anyway. For these two reasons many electric utility companies avoid in all or in a part of their schedules the complication occasioned by the measuring of the maximum demand and use substitutes for the measured maximum demand which are more easily determined, even though by the additional approximation a further element of inaccuracy is introduced.

The possibility of substituting other values for the measured maximum has already been proviously mentioned, in Section 129. It has been stated there that these substitutes, such as connected load and number of sockets, are not popular among central-station managers for the flat rates other than display lighting. It is different in case of the rates which are based on both the maximum demand and the energy consumption. Here the inaccuracy introduced by the employment of a substitute for the real maximum demand of the customer affects a portion only of the total charges, so that the inaccuracy is, so to speak, diluted. A customer who increases the wattage of his lamps or the number of his sockets will in general also increase his energy consumption and therefore he will not get for nothing the additional, and possibly fraudulently obtained, service, as he would in case of a flat rate.

Insert XV—Appendix to Sections 53 and 137.

EXPLANATION OF THE TERM POWER-FACTOR AND ALLIED TERMS.

(For the nontechnical reader.)

In case of purely heating and incandescent lighting loads the power in watts consumed by the customer is given by the product volts × amperes. The number of the kilowatts is of course only 1/1000 of this value, as the unit of kilowatt is 1000 times as great as the unit watt. The power in kilowatts with such loads is therefore $\frac{\text{volts} \times \text{amperes.}}{1000}$.[1] With certain other loads, the so-called inductive or reactive loads, notably with most motor loads, the physical conditions in alternating-current circuits are such that the power which is produced by a certain current at a given voltage is smaller than the term $\frac{\text{volts} \times \text{amperes}}{1000}$ indicates. A larger current is therefore necessary with these loads to produce a certain power in a given system (that is at a given voltage).

Now the "capacity" or "size" of generators and transformers is determined by the product of volts × amperes and since in a given electric system of the most common type the voltage is constant, a generator or transformer of a given size can supply less power with inductive load than with noninductive load.[2] Also the copper sections of transmission and distribution lines depend on the current they have to carry and a given line will therefore not be able to carry as much inductive load as noninductive load. We see from this that it is cheaper to supply noninductive load because the electrical supply equipment is smaller and therefore cheaper. Moreover, the maintenance of proper voltage is more difficult with inductive load.

The term $\frac{\text{volts} \times \text{amperes}}{1000}$ is called the "apparent kilowatts" or the "apparent power." The apparent power is equal to the real power only in case of non-inductive (non-reactive) load, otherwise it is always larger. The unit of apparent power is the "kilovolt-ampere," which is 1000 times the apparent power delivered by one ampere at one volt, with single-phase current, just as the kilowatt is 1000 times the real power delivered by one ampere at one volt on noninduc-

[14] Wholesale Power and Lighting schedule, Birmingham, Ala.: If no demand indicator is used, the demand in kilowatts is assumed to be four times the highest recorded consumption in kilowatt-hours for any 15-minute period.

Primary Power Service, Buffalo: The demand is determined by the kilowatt-hour meter for 2 minutes, or by an indicating or graphic recording wattmeter.

[15] For instance, Cambridge, Mass., has pure block meter rates, but the knowledge of the customer's demand is necessary for writing out the bill in one of the schedules, because the minimum monthly charge is based on it and another one of the schedules applies only for the customers whose load-factor exceeds a specified minimum. The demand in these cases is determined as the average of three 5-minute readings of the watt-hour meter (or, in case of low power-factor load, of a voltmeter and ammeter), the readings to be made with the use of a stop watch.

[16] General Power schedule in South Bend, Ind.: 50%; Optional Commercial Lighting schedule of the Universal Electric & Gas Co., San Francisco: 60%.

[17] General Power schedule of Fitchburg, Mass., and Haverhill, Mass.; 75% of the measured demand.

[18] Auxiliary Lighting and Power schedule, Buffalo: Demand limited by fuses or other device. Auxiliary Power, Cleveland: The customer shall install an automatic circuit-opening device which the company will set and seal for an amount slightly above the demand contracted for.

[1] This applies to direct-current and single-phase alternating-current circuits. In case of three-phase circuits this product must be multiplied by 1.732 here and in the following.

[2] This does not mean that power is lost (except in a secondary way). The generator is simply unable to deliver as much power without undue heating and it can, therefore, not receive as many horsepower from the prime mover. It is designed and built as a larger "generator" with corresponding cost but can operate only as a smaller one if the load is inductive. Transformers are affected in the same way.

tive load with single-phase current. A kilovolt-ampere furnishes one kilowatt in case of noninductive load, otherwise less.

The ratio of the real power to the apparent power is called the power-factor. In central-station practice the power-factor is expressed in per cent; "80% power-factor" means that the real power is 80% of the apparent power. The power-factor can never be larger than 100%. In case of noninductive load it is equal to 100%, while for inductive load it is smaller. The power-factor of small motors is smaller than that of larger motors, and for a given individual motor it decreases as the load on the motor decreases. This refers to asynchronous (induction) motors. In synchronous motors the power-factor can be regulated by the exciting current.

All our readers will probably be familiar with the fact that in alternating-current circuits the direction in which the current is flowing is continually reversing and at a very rapid rate too, in most of our central-station systems 120 times a second. It increases from zero to its maximum value in 1/240 second, then decreases in the next 1/240 second again to zero, reverses its direction, reaches its maximum in the opposite direction after the third 1/240 second (negative maximum), again becomes zero and thus after 4/240 or 1/60 second begins the same cycle as described. The same applies to the voltage. The speed with which the voltage varies is exactly the same as that of the variations of the current (namely 120 reversals of the direction every second), but the current does not in every case reach its maximum (or its zero value) at the same instant as the voltage. It may be, for instance, always 1/500 second ahead of the voltage, or it may be a little behind the voltage. In the former case we say the current is "leading," in the latter it is "lagging." If the current and the voltage both reach their maximum at exactly the same instant, that is, if the current is neither leading nor lagging, we say current and voltage are "in phase."

The machinery in the central station determines the number of reversals per second, the character of the load determines whether the current is leading, lagging, or in phase.

Now noninductive load means nothing else than that current and voltage are exactly in phase. Then the power-factor is 100%. If they are out of phase we have a power-factor of less than 100%. We see from the above that if the power-factor is smaller than 100% this may be due either to a leading or to a lagging current.

As may be expected, the lag of the current of one customer may be balanced partly or wholly by the lead of the current of another customer, so that the supply of the two together may combine into a current in phase or at least less out of phase. The generators, transformers, etc., will then have to supply current which is less out of phase, the power-factor will be raised and the undesirable effect of a low power-factor on the central station and lines will be reduced.

Now the ordinary asynchronous or induction motor has such characteristics that it can only draw a lagging current from the system. Conditions of the customer's load which make the current lead the voltage are practically found only in the so-called synchronous motors under certain methods of operation (overexcitation.) These synchronous motors are practicable in exceptional cases only for large sizes and under certain other conditions. This explains why in Sioux City (see footnote 11, Section 137) the increase of the demand charges in case of small power-factors is restricted to lagging currents.

Insert XVI—Appendix to Section 140.

Instruments for Measuring the Maximum Demand.

One type of demand-measuring instruments is working in connection with the ordinary service watt-hour meter of the consumer. A contact mounted on the wormwheel of the watt-hour meter makes and breaks a circuit at a rate proportional to the speed at which the meter disk revolves, that is, proportional to the power which passes through the meter. Every time the contact is made, a member in the demand-indicating instrument is pushed forward a small fixed amount by means of an electromagnet and a ratchet. This member may be either a stylus (if a graphic record is desired) or a driving dog which pushes a friction pointer forward on a dial. After a prearranged interval over which the demand is to be averaged has elapsed (5, 10 or 30 minutes, one hour, etc.) the above mentioned stylus or driving dog is disengaged by the action of a clock and drawn back to zero position by spring action. The stylus in the recording type of instrument then begins a new mark on the sheet or disk of paper which is creeping or revolving underneath the stylus. The driving dog in the other type of instrument on its withdrawal leaves the friction pointer lying in the position to which it had been pushed previously, so that the pointer always indicates the highest position which the dog has ever reached since the pointer was reset the last time by hand. From the chart of the recording instrument (called "demand indicator" by the manufacturers in contradistinction to the dial instrument, which is called "demand meter") we have then to select the highest mark as indicating how large the highest demand was and when it occurred, whereas in the dial instrument we can read directly from the position of the pointer how large the maximum demand has been since the last resetting of the instrument, but not when it occurred.

Another type of instrument for measuring the demand is the "Wright maximum-demand meter." It consists of a U-shaped glass tube partly filled with liquid and sealed at both ends. At each end (both of which in the normal position point vertically upwards) the tube is widened into a bulb. Just below one of these two bulbs the vessel communicates with the upper end of a graduated vertical overflow glass tube, which is sealed at its lower end. (The whole arrangement is therefore hermetically sealed on all sides.) The bulb on the other leg is surrounded by a coil of resistance wire connected in series with the consumer's installation. The heat generated in the coil by the current expands the air in that bulb and forces a portion of the liquid out of that leg, making the liquid overflow at the other leg into the vertical overflow pipe. The liquid will remain in the latter even after the coil cools off and thus the amount of liquid contained in the graduated tube is a measure of the maximum current, which has been passing through the coil since the last resetting of the instrument. This resetting is made by tilting the instrument so that the liquid can run back into the U-shaped tube. The whole instrument is enclosed in a cast-iron casing and hinged, so that the electric light company's inspector can easily tilt the instrument for resetting after he has made his periodic reading.

As this instrument acts on the heating capacity of the current it will at fluctuating loads register differently from the electromagnetic instruments previously described, which base their registry on the energy delivered. The Wright demand meter is rated to record as follows (from Foster, "Electrical Engineer's Pocket Book"):

If the maximum load lasts 5 minutes 80% will register.
If the maximum load lasts 10 minutes 95% will register.
If the maximum load lasts 30 minutes 100% will register.

If we have, for instance, a load of 1 kw. (1000 watts) for 5 minutes and no load for the following hour this combination of loads will register on a Wright demand meter as 800 watts, whereas an electromagnetic instrument will record the following maximum demands:[1]

If the instrument is set for 5 minutes or less: 1000 watts.
If the instrument is set for 10 minutes: $1000 \times 5/10 = 500$ watts.
If the instrument is set for 30 minutes: $1000 \times 5/30 = 167$ watts.

As the Wright instrument records 100% of the demand after 30 minutes duration of the full demand, the comparison might be made with an electromagnetic instrument set for a 30-minute interval. Supposing now the full load of 1000 watts to be turned on for a number of minutes, as shown in the first column of the following table, and no load for the rest of the time, the registries will be:

Duration of 1000-watts Load	Electromagnetic Instrument Set for 30 minutes	Wright Demand Meter
5 minutes.....	167 watts	800 watts
10 minutes.....	333 watts	950 watts
30 minutes.....	1,000 watts	1,000 watts

We see from these comparisons that the Wright demand meter is more sensitive to high demands of short duration than the electromagnetic devices. This will not surprise the engineers among our readers as they know that the heating effect increases with the square of the current.

It seems reasonable to assume that the heating effect of various percentages of load acting for various periods of time on the air in the bulb of the Wright instrument is more or less similar to the heating effects on electric machinery and equipment; the way in which the Wright instrument responds to various loads may therefore to a certain degree express the effect of an overload on the necessary size of the capacity of the power-house machinery, etc., and with that on a certain part of the capital invested and the corresponding demand charges.

We cannot, however, by any means say that the way in which the Wright demand meter responds to various dura-

[1] Provided that this 5-minute interval of 1000 watts starts at the same moment when the electromagnetic instrument starts its own interval of readjustment, that is, at the moment of the disengagement by the clockwork.

tions of overload is preferable to that of the electromagnetic instruments. (Compare also Sections 36 and 37). In the first place a certain part of the electric light company's equipment, notably the distribution lines, have no time element in the way they respond to overloads; this means a short overload on the distribution lines will at once show its full effect on the quality of the service (by an excessive voltage drop). In the second place the heating and cooling curves of the various parts are different from one another and different from that of the Wright instrument. In the third place we have moved so far away from the exact theoretical requirements by the various successive approximations made[2] that these nice distinctions lose their importance alongside these approximations.

(To be continued.)

CONDITIONS FAVORING AND FACTORS INFLUENCING ELECTRICAL UTILIZATION OF BLAST-FURNACE GASES.

British Fuel Economy Committee's Report Advocates Cleaning Gases and Efficient Use.

In the course of a report on fuel economy and consumptions in the manufacture of iron and steel, which came before the autumn meeting of the Iron and Steel Institute in London, England, recently, Prof. W. A. Bone, Sir Robert Hadfield, and Alfred Hutchinson in the course of a review of their conclusions said that the result of their investigations proved beyond all question that much remained to be done before British iron and steel works would have attained to anything like the practical ideal of fuel economy which at least three leading iron and steel makers had declared to be even now attainable. Among other directions in which economies could be effected was the utilization of waste gases from boilers, stoves, furnaces and soaking pits. Such satisfactory progress was now being made with the electrostatic cleaning of blast-furnace gases, that the day might be confidently anticipated when all gas, whether required by stoves or engines, would be so cleaned. This would undoubtedly increase the thermal efficiency of the hot-blast stoves, and make a larger surplus of gas available for the steel works. Speaking of the utilization of the surplus gas for power purposes, it seemed a barbarous practice, said the authors, to burn uncleaned blast-furnace gas in Lancashire boilers, whose efficiency probably did not exceed 55%, when (if cleaned) its potential energy could be transferred into electric power via the gas-engine and the dynamo. The day was fast approaching when, in steel works adjacent to blast furnaces, all stationary machines (including blowing engines, cranes, and rolling mills) would be electrically driven by current generated from the explosion of blast-furnace gas in internal-combustion engines. Even now, steam-driven reciprocating blowing engines should be superseded by electrically driven turboblowers. When such reforms had been carried out in connection with the blast-furnace plants they might look for the abolition of the "gas producer" in the adjacent steel works, a step much to be desired.

In the course of their reference to the problem of isolated blast-furnace plants, the authors said it would, as a rule, undoubtedly pay any firm to make coke in its own regenerative by-product ovens on a site adjacent to the blast furnaces. In the case of a Cleveland furnace making 1000 tons of pig iron per week, and using no more than 22.5 cwt. of coke per ton (which means working under the best possible conditions) it could be shown that the total gas made per hour at the furnaces would be about 1,115,000 cu. ft. at 60° F. and 30 in. barometer. If this were electrostatically cleaned and used to the best advantage on the plant, half of it should suffice to generate and heat the blast. The potential energy of the other half, if converted into electric power with an overall efficiency of 20% would be capable of developing 3350 kw. continuously at the switchboard. The available surplus coke-oven gas would amount to a further 48,000 cu. ft. per hr., or sufficient to generate about 1150 kw. continuously. Hence the total available power from the combined gases would attain about 5000 kw. continuously. This did not take any account of power derivable either from the stove waste heat or gas-engine exhaust, or yet of the heat carried away in the molten slag and iron, all of which might be turned to profitable use. The best way of disposing of such surplus gas and waste heat would be to sell them to an electric power company for conversion into electricity; but, if there was no power company near at hand to buy the energy then it might be used to generate electricity for some electrochemical process, such, for instance as (1) the manufacture of nitric acid from the air, or (2) some electrometallurgical or electrolytic operation. "What ought to be realized is that the combined by-product coke-oven and blast-furnace plant is not only an efficient producer of iron, but that it simultaneously, and of necessity, generates a most valuable power gas, of which the utmost use must be made in the interests of national economy."

The same subject was covered further in a report prepared by Cosmo Johns and Lawrence Ennis for the Iron and Steel Institute "On the Present State of Fuel Economy in the German Iron and Steel Industry of the Occupied Territory on the Left Bank of the Rhine." They stated: (1) The blast-furnace gas should be cleaned, without loss of sensible heat, if the conditions render it possible, until the dust content is at least as low as 0.1 gram per cu. in. It is only when this has been done that the gas can be used economically for any purpose in iron and steel works practice. It is only thus that any useful surplus can be obtained for use in the steel works. Gas intended for use as fuel in internal-combustion engines should, of course, be still further cooled and cleaned. (2) All power, whether compressed air for blast furnaces or converters, or electric energy, should be generated in gas-driven prime movers, with only such steam turbines as are found necessary to deal with fluctuating loads. As much steam as possible should be furnished by waste-heat boilers attached to the large gas engines. These waste-heat boilers should be of the fire-tube type, not water tubes. (3) If the linking up of the power stations of neighboring works is possible, then the whole of the steel works should be electrically driven.

CITY SAVES $15,000 THROUGH CENTRAL-STATION SERVICE.

Two years ago the city council of Grand Forks, N. D., signed a contract with the Red River Power Co. for electric energy for operation of its water pumping supply system and street-lighting system. At the Oct. 6, 1919, meeting of the city council the report of expenditures for electric power showed that in the 23 months of the contract the city had saved $14,846, compared with the cost of operating its own plant.

[2] Compare Insert V and the additional assumption that the consumer's maximum demand is proportional to his peak responsibility, and that the latter is the correct portion of the central station's capacity for which the customer should be charged; see Insert VI.

Military Searchlights and Their Scientific Testing

Review of War's Very Striking Developments in This Field of Light Projection — Power, Mobility and Utility Greatly Improved—Important Developments in Searchlight Testing

AMONG the most important engineering developments of the World War was the big stride in improvement of big searchlights. Doubtless the most complete general review of these achievements was presented in a paper by Capt. Chester Lichtenberg, U. S. Army, read before the recent Chicago convention of the Illuminating Engineering Society. Extracts from this paper are given herewith, followed by extracts from an article on searchlight testing by F. A. Benford, of the Illuminating Engineering Laboratory, General Electric Co., which article appeared in a recent issue of the General Electric Review. The rapidity and success of these searchlight developments was due in large measure to the splendid co-operation of the research scientists and engineers of progressive manufacturers with the engineers of the Army. Each step in the development of powerful and mobile searchlights was verified by painstaking tests calling for new methods and apparatus, the principal ones of which are described herewith.

SEARCHLIGHTS have been used for military purposes for over fifty years. They are essentially war materiel, although in recent years they are being used for special illumination work. Their military application has been varied according to the strategy employed and the tactics involved. Their development has been spasmodic, resulting from immediate needs in war times with practically no peace-time demands. Their testing has been difficult owing to the many independent variables and the large parameters involved.

The startling events of the past four years have caused marked changes in military affairs and required fundamental and radical alterations in many lines of equipment. Searchlights are included in that class of materiel which experienced undreamed modification. They received a design and application impetus during the past two years which has more than counterbalanced the relative inactivity of the preceding fifteen years.

Service.—Searchlights are used by military organizations for detecting and illuminating distant targets. The visible area, color contrast, shape and relative speed of the targets varies through wide limits. They may be grouped in classes as follows:

1. Buildings, intrenchments, bodies of troops, and similar large stationary or essentially stationary targets on land.
2. Automobiles, motorcycles, bicycles, horsemen, small bodies of troops, and similar agile and fast-moving targets on land.
3. Battleships, troop ships, and similar slow-moving targets on water.
4. Destroyers, motorboats, rowboats and similar small, agile or fast-moving targets on water.
5. Bombers, and similar cargo-carrying and sluggish targets in air.
6. Scouts and similar fast agile targets in air.

The service requirements determine in a large measure the desirable characteristics of the most suitable searchlight. Distant targets require beams of great penetrating power, hence a beam of minimum divergence is sought. Near targets require beams of relatively great area-covering power, hence a beam of maximum divergence is preferred. Fast-moving targets demand an agile control of great responsivity. They require a beam of relatively wide divergence for their continued illumination. Slow-moving targets may use a beam of relatively small divergence if the beam fully covers them at the nearest range to which they will be permitted to approach. So for each kind of target there is a beam which will best detect and illuminate it.

The year 1917 found the nations of the world confronted with at least one new problem. The science of aeronautics had developed with astonishing rapidity. High-speed airplanes of huge carrying capacity were sent hundreds of miles under cover of darkness distributing terrifying and death-dealing missiles throughout wide areas. The destruction of life was serious. The undermining of the morale of the civil and military population threatened defeat.

The tactics were new. No counter efforts were known. Means for detecting the raiders were demanded. Searchlights were suggested, tried and found effective. The available materiel was, however, ill adapted for aerial service. It had been designed for detecting and illuminating land and water targets. The elevation range was limited to about 30°. The designs were heavy and immobile, being intended for installation in fixed fortifications. The control was sluggish, being intended for following relatively large and slow-moving targets on the earth's surface.

A survey of the situation was ordered by Maj. Gen. Wm. M. Black, the chief of Engineers, United States Army, in the early fall of 1917. It was inaugurated by Col. R. S. A. Dougherty, Engineers. The investigation covered existing European practice and the probable trend of the art.

It was found that the targets were new. They moved above the earth's surface at altitudes up to 25,000 ft. They were remarkably fast and agile. They were colored so as to blend with the backgrounds that they used. They moved singly or in formations. They were accompanied at times by screen or decoy units. They presented relatively small visible areas making detection at a distance difficult, even by day.

Problems.—The problems disclosed were many and difficult. Searchlights to meet the situation seemed to require new characteristics. They must have a relatively wide field to rapidly search a given area of sky. They should have a beam of good and well distributed illumination effective at ranges from 5000 to 25,000 ft. Their design must be simple yet rugged since only inexperienced operating personnel would be available. They must be relatively light in weight to permit rapid movement from point to point. They must be relatively small in size to permit convenient intrenching. They must have reliable, silent and mobile power units which must not only carry the searchlights and personnel, but must furnish the power to operate the searchlights. The control must be simple, capable of operating the searchlights very fast for changing direction of search and relatively slowly for searching. It must permit searching through 240° in elevation and indefinitely in azimuth.

The requirements were new. Existing facilities were limited to a few standard barrel searchlights each week. Thousands of units were needed immediately. Increasing production of developed designs was difficult because of the acute labor shortage. It was, therefore, imperative that new design and manufacturing facilities be sought and developed.

Mobilization.—Mobilization of existing resources was started in the spring of 1918. The principal manufacturers of searchlights and searchlight equipment were approached. The problems were presented to them. They were induced to assign new groups of engineers, designers and mechanics to the task. The aid of prominent scientists was enlisted and fundamental problems presented to them for solution. Close liaison was established with the American Expeditionary Forces in France. Advantage was taken of the facilities of the National Research Council to maintain contact with established scientific organizations of the Allied nations. Every source of information or assistance was probed and advantage taken of each bit of data obtained.

Determinations.—The determination of the characteristics of existing searchlights and searchlight equipment was the next step taken. Existing methods were investigated. They were found to be antiquated and inaccurate. Expert assistance was sought. Dr. C. G. Abbott of the Smithsonian Institute, I. G. Priest, E. C. Crittenden and A. H. Taylor of the Bureau of Standards, Physicist Enoch Karrer of the Army Engineers, W. D'A. Ryan and F. A. Benford of the General Electric Co., and Preston R. Bassett of the Sperry Gyroscope Co. were consulted. In co-operation with the officer in charge, searchlight investigations, United States Army, they surveyed the field, analyzed the problems involved, and developed and applied new and novel methods of determining the characteristics of searchlights for land, water and air service.

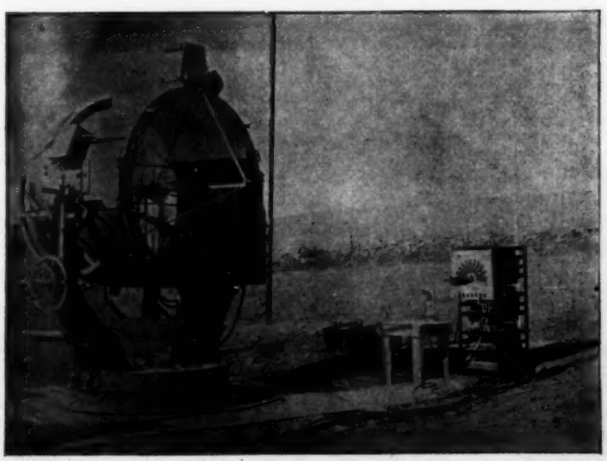


Fig. 1.—Full Automatic High-Intensity Searchlight in Coast Fortification Type Drum—On Account of Bulk and Weight This Outfit Was Not Suitable for Mobile Service.

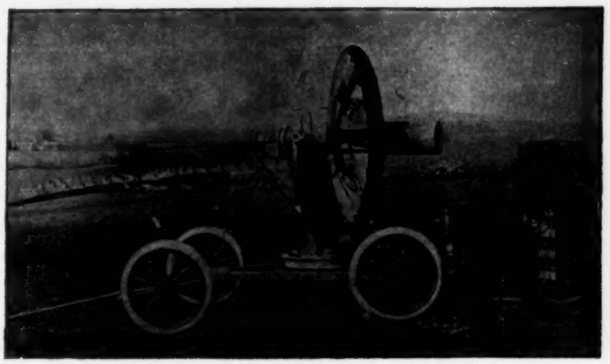


Fig. 2.—An Early Model of the 60-in. Open Type Medium-Intensity Searchlight Adopted for Army Use—This and Later Types Were Much Lighter, More Portable and More Powerful Than the Type Shown in Fig. 1.

Arc illumination is the basis for all searchlight calculations. The amount of light energy available, and its distribution are vital factors in projecting beams. Methods for determining the characteristics of arcs and other similar sources of light used in searchlights were developed by Messrs. Crittenden, Karrer and Benford.

Messrs. Crittenden and Karrer determined arc illumination by the use of mirrors and a photometer. The arc and photometer were held fixed in position. The mirrors were rotated around the arc step by step in three great circles. Photometric observations were made at each step. The observations were plotted and a characteristic curve obtained. The curves gave direct means for comparing the various arcs and other light sources used or considered for searchlights.

Mr. Benford used a hollow hemisphere with its concave side receiving and collecting the light. A reflecting surface at the focus and a photometer located outside the hemisphere complete the equipment. The observations give the total light from the arc or the beam when a mirror is placed behind the arc.

The determination of the most suitable color of searchlight beams was a problem of absorbing interest. This characteristic was found dependent principally on the temperature of the source. At relatively low temperatures, that is, with low-intensity arcs having a current density of about 0.1 ampere per square mm., the color is reddish-yellow. Ingredients in the cores of the carbons can be used to modify the color slightly. At intermediate temperatures, such as produced by medium intensity arcs having a current density of about 0.4 ampere per sq. mm., the color of the beam is greenish-yellow. Ingredients in the cores of the carbons have little modifying effect on the color. At high temperatures, such as produced by high-intensity arcs with a current density of about 1.0 ampere per sq. mm., the beam color is bluish-white and is uninfluenced by ingredients in the cores of the carbons.

The colors of searchlight beams can be accurately

controlled by the use of filters. These reduce the amount of light in the beam from 20 to 50 or more per cent. Their use has been abandoned for military purposes, where the amount of light is of paramount importance.

Absorption.—The absorption of searchlight beams under various atmospheric conditions has been studied. The investigations have not been completed. They are still in progress. Initial results indicate that the amount of light returned to an observer near the searchlight varies inversely as the sixth or seventh power of the range. It has also been found that the shorter wave lengths of light energy are absorbed more rapidly by the earth's atmosphere than the longer wave lengths. Experiments with a blue-white 150-ampere high-intensity arc in a 60-in. parabolic glass mirror showed the beam to appear distinctly yellow at 20 miles. Radiometer tests show that 75% of the light energy in the yellow part of the spectrum is dissipated in 7.2 miles of clean dry air near the earth's surface.

Front Glass.—The front glass or door or lens of a searchlight was first given attention by Dr. Abbott. While observing a searchlight beam he remarked the large diffusion caused by the front glass. Later investigation revealed that the glass used was relatively poor optically and that it diffracted some of the light of the beam. It was also found that dust and dirt on the front glass further reduced the light in the beam.

Tests were made to determine the ordinary light losses caused by the front glass. Three organizations co-operated. They made an exhaustive series of measurements at ranges from 1000 to 3000 ft. It was found that the front glass cut off an average of 25% of the beam light.

Searchlights were next operated without front doors. Trials were made with 24-in. barrels containing 75-ampere high-intensity arcs, and 36-in. and 60-in. barrels with 150-ampere high-intensity arcs in all kinds of wind and weather. Their operation was found successful in all but rare combinations of wind and angular position of the searchlight barrel. In these cases it was found that the walls of the barrel caused eddies of air which disturbed the arc stream. The successful operation of barrel searchlights without front doors was a leading factor in suggesting the development of open type searchlights.

Target Finding.—Target-finding determinations proved a most interesting and valuable contribution to the art. Previous investigators had contented themselves with separate photometry or other measurement of searchlight arcs and beams. The lack of suitable standards, the intensity and unsteadiness of the source and the important effects of atmospheric absorption were neglected. The results were neither absolute nor comparative.

The limits of the older forms of testing were soon realized. It was seen that more reliable methods were necessary. The field was carefully surveyed and the problem studied. A return was made to first principles. One or more sources of light comparable with the source to be examined were arbitrarily made standards. These were chosen from sources which had been or were being used under service conditions and concerning whose performance some data were obtainable. The visibility of distant targets illuminated alternately by the standard sources and the unknown source was determined when viewed by a number of observers at service distances from the source and the targets.

Fixed-area targets were the first form used. They were 18 in number. They were rectangular in shape. Their sides were in the proportion of 5:1. They were painted dull black. The largest had an area of 500 sq. in. The smallest had an area of 2.5 sq. in. They were located on a sky line about 3000 ft. from the searchlight under test. The number visible when illuminated by any beam gave an indication of the finding power of that beam. The inverse relation of the least mean areas observable when illuminated by the several searchlights gave a comparison of their relative finding powers.

Variable-area sky-line targets followed. They consisted essentially of a long canvas roll mounted on a cylinder in the same fashion as a window curtain. The surface turned toward the searchlight was painted dull black or in a series of combinations of dull white and dull black. They are used in the same manner as the fixed-area targets. Their principal advantage is that the observations with them are less likely to be biased since the observers have no gauge of the least area visible.

Airplanes and ships are being used extensively as comparison targets. They are the preferred kind. Their use is relatively simple. They are caused to pass successively through the standard and unknown beams at 6 to 10 ranges on 3 or 5 or more nights. The number of times they pass through each beam is noted by observers on them. The number of times they are seen to pass through the beams is noted by observers located at service positions. A ratio of the mean number of times the targets are observed to pass through the beams and the actual number of times they pass through gives an indication of the finding power of the beams. A comparison of the ratios of standard and unknown beams gives a direct comparison of their finding powers.

Comparison target-finding tests are based on the assumption that lights of known finding power under service conditions are used as standards. These tests then form a simple, accurate and rapid method for the determination of the service utility of a new or modified searchlight. The tests were used with marked success in comparing mirror sizes, mirror colors, mirror shapes, front-glass losses, medium and high-intensity arcs, color screens and over 20 designs of searchlights.

Observer's Position.—Observer's positions have always been known to influence the finding power of a searchlight. Many observations were made from time to time, but no co-ordinated results obtained. The problem was given special attention in the spring of 1918. A series of tests was made with airplane targets at Ellington Field, Texas. A 36-in. barrel searchlight with a 150-ampere high-intensity arc, 40 observers on a 6000-ft. base line and an airplane flying at elevations from 3000 ft. to 6000 ft. and ranges of 10,000 ft. to 20,000 ft. were used. Observations were taken on a number of nights. Over 800 readings were obtained. The collated results indicate that the best observing position is in the axis of the trunnion of the searchlight and from 300 ft. to 1000 ft. distant from it.

Designs.—The design of searchlights and searchlight equipment to meet the new warfare conditions required radical changes in the fundamental ideas previously held. The service needs were collected and analyzed. The views of collaborators and liaison officers were obtained. Future operations and tendencies were considered. Problems were formulated and assigned to selected groups of engineers. Their

queries were invited and answered. Their products were examined during the progress of development. The final samples were given rigid and exhaustive tests.

Five designing engineers with their assistants co-operated with the War Department. Each formed a group of keen, skilled enthusiasts whose knowledge, interest and efforts resulted in the successful development of a number of new, novel and epoch-making designs.

Barrel Searchlights.—The barrel searchlights available at the beginning of hostilities were intended for fixed installations. A portable type was needed. The problem was submitted to the Sperry Gyroscope Co. and the General Electric Co. They assigned Preston R. Bassett, John L. Hall and E. J. Murphy to consider the requirements. The first result of their study was a standard 36-in. barrel searchlight with a four-wheeled carriage instead of the remote-control base. This reduced the weight from 4000 to 1600 lbs. Next they modified the design and produced a 60-in. light barrel weighing 1800 lbs. complete with carriage. The mechanisms of these searchlights are noteworthy. They are automatic yet very simple. The number of parts in them is less than one-fifth of the number in the previous standard designs. They weigh only one-fourth as much as the standard designs, yet are more rugged and function better.

Open Searchlights.—The open type searchlight was conceived by Maj. Richard Wheatley Lewis, Engineers, in May, 1918. He was deeply impressed with the need for a lighter-weight searchlight than any available. He saw the desirability of having one which would combine lightness with ruggedness, simplicity and ease of operation. He studied the results of experiments made in the United States and sketched a design which eliminated all but the basic essentials of a searchlight.

The problems of design were submitted to a group of army engineers, the General Electric Co. and the Sperry Gyroscope Co. Capt. L. C. Josephs, Jr., and C. A. B. Halvorson and P. R. Bassett were assigned to crystallize Major Lewis's conception. They developed and within two months placed in production a 60-in. searchlight of remarkable properties. It weighed only one-fifth as much as the previous standard. It had one-twentieth of the bulk and cost only half as much. It was infinitely simpler and could be produced in less than one-fourth the time required to produce the old standard. It used the same mirrors and carbons as the old designs. It was uniquely adapted for the service conditions encountered.

Improved open type searchlights followed the successful initial designs. The carriage was made stronger and lighter. The mechanism was made simpler. A tripod mounting was made for a 30-in. size. A litter carrier was made for the 60-in. size. The finder was simplified and improved, the controls bettered. The result is a searchlight design which will accommodate the wide variety of arc light sources and mirrors to meet the many service conditions encountered.

Power Units.—Mobile power units were as essential as mobile searchlights. They were required to be dependable and quiet in their operation. Their design was submitted to Maj. Lorimer D. Miller and Capt. L. C. Josephs, Jr., Engineers, and Harry S. Baldwin of the General Electric Co. Two schemes were developed. Both used an automotive engine as prime mover. One is the so-called Mack design. It had the generator located in front of the engine and supported beyond the automobile chassis. The other is the so-called G. E. Cadillac design. It had the generator located on a quill between the automobile transmission and the differential and supported inside the automobile chassis.

The Mack design was an adaptation of French practice developed during the war period. It eliminated the belts, chains and other links of the French systems and placed the generator on an extension of the engine crankshaft. This design permitted standard truck units to be modified and used as mobile searchlight power units. It also permitted a limited operation of the searchlight and truck motive power simultaneously. The design was projected in December, 1917. One hundred and eighty units using 5½-ton Mack trucks were built. They were equipped with extra radiator and extra water supply and carried a 115-volt, 15-kw. generator, a 36-in. wheeled barrel searchlight, 500 ft. of cable, rheostats, etc. About 30 units reached the American Expeditionary Forces in France where they were successful on hard roads.

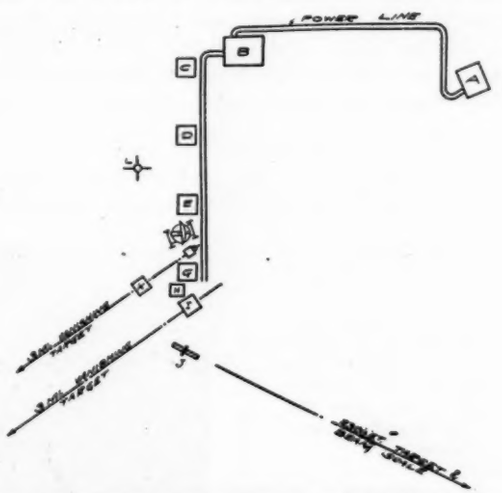


Fig. 3.—General Ground Plan of Searchlight Station.

(A) Power house; (B) general test house; (C) 60-in. high-intensity drum type projector; (D) 60-in. low-intensity drum type projector; (E) 60-in. high-intensity drum type projector; (F) 60-in. medium-intensity army open type projector; (G) incandescent projector; (H) wireless telephone station; (I) sectored disk for visibility test; (J) 6-in. telephotometer; (K) 15-in. telephotometer; (L) antenna of wireless telephone.

The G. E. Cadillac design was a distinct departure in power unit construction. Similar to the Mack, it uses a standard automobile engine and chassis. In addition, however, it uses the standard water reservoir and cooling equipment. The generator is placed concentric with the propeller shaft and connected to it through a quill. A standard Cadillac clutch and gear-shift lever enable the engine to be connected to either the generator or the automobile propellor shaft.

The Cadillac idea was suggested in June, 1918. A sample was ordered in July, 1918. Delivery was made in September. A short but thorough test was made in the United States. The sample was then shipped to France where it was received and placed with the Second American Army early in October. It carried a 105-volt, 20-kw. generator, 600 ft. of cable, and a 60-in. open type searchlight. Ninety additional units were authorized soon after the sample was started.

Extensions of the Cadillac idea have been made. A 50-kw. unit has been completed. A 7-kw. unit is being constructed. The three models form a unique

line of portable power units employing automobile designs which have been standardized for the general service in the Army.

The future of military searchlights is assured. The remarkable advances in aeronautics alone provides a wide field for their employment as detectors, beacons, landing lights and signals. Their development has but just started. They will undoubtedly be wonderfully improved in the next decade.

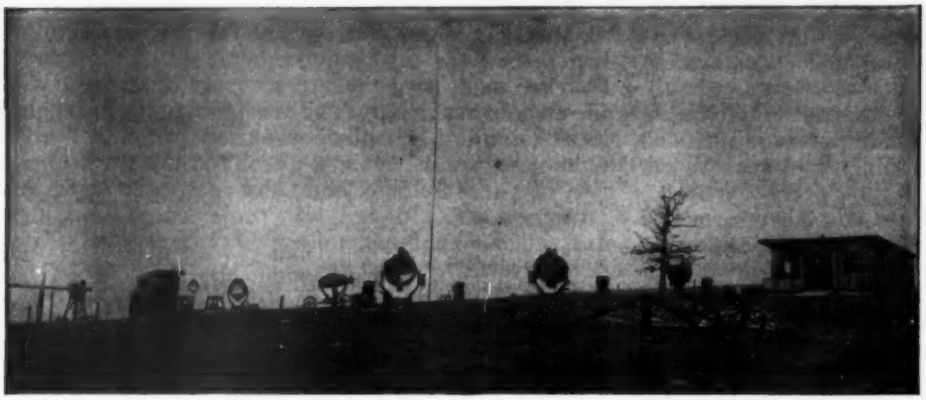


Fig. 4.—General View of Searchlight Station—Test House at Extreme Right.

Searchlight Testing.

The characteristics required of an anti-aircraft searchlight are: Mobility, durability under rough usage, reliability under all circumstances, ability to operate at any elevation of axis or even upside down, good luminous efficiency, and quietness of operation. When to this list is added the fact that the positive electrode is often at a blazing white heat for its entire length and many parts of the lamp are red hot during a protracted run, it is seen that the design of an operating projector is not a simple matter. Several of these requirements were entirely new, and some idea of the radical changes in the new projector may be gained by a glance at the illustration of the old fortification-type searchlight, Fig. 1, and the army open-type searchlight, Fig. 2. During the tests that accompanied the development of the new type searchlight, every part of the projector had to be kept under constant observation and the interested engineers kept posted. The scheme and scope of the testing was laid out by W. D'A. Ryan, and all actual test work was done by members of the Illuminating Engineering Laboratory of the General Electric Co. Following each test, technical reports were made to the General Engineer Depot, U. S. Army, covering first, fairly complete original test data and notes on operation; second, a summary and comparison of the data; and third, a judgment on the thing tested.

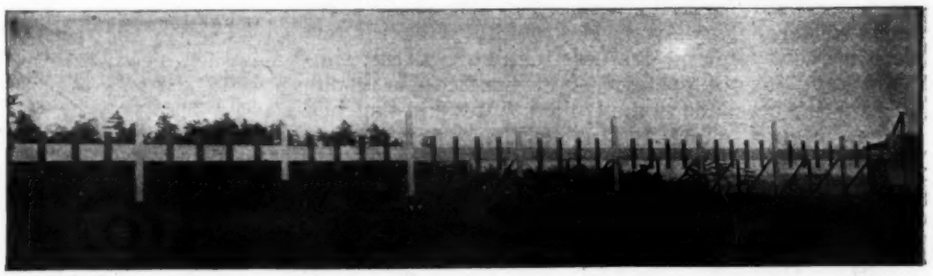


Fig. 5.—Close-up View of the Beam Scale and Photometer House—Note Size as Compared with the Man Standing Near Middle.

The principal source of information was the outdoor searchlight range on the Schenectady-Duanesburg road. Here was equipment for operating and testing the numerous types of searchlight, singly or in groups. The test work fell into three classes: first, a mechanical or operation test of the searchlight or carbons; second, a test of the relative revealing power of the searchlights; and third, a photometric analysis of the beams of light. The last class of testing took up the greater part of the time, but the three classes were always more or less interwoven and proceeded simultaneously. To the uninitiated, the amount and

Fig. 6.—The 2300-ft. Target and Beam Scale as Viewed from Searchlight Station — Horizontal Scale is 5° 30′ Long, and Vertical Scale is 1° 30′ High.

scale of testing apparatus is amazing, and the labor involved in choosing between two identical appearing carbons seems beyond all reason. The explanation is simple enough for sheer difficulty—searchlight photometry stands in a class by itself. There are several factors, such as current and voltage, that are under control; several others, such as crater formation and steadiness of burning, that can be observed but only slightly controlled; and finally, there is the action of the atmosphere, which cannot be controlled, and until this station was built was probably never before measured as a regular part of the photometric testing of a searchlight.

The country around Schenectady was thoroughly examined before a suitable location was found on the Schenectady-Duanesburg road about five miles from Schenectady. This location is entirely free from smoke and river fog. The power station and searchlight are located on a hillside having a free view across a wide shallow valley. A high point of ground 2300 ft. away was selected for the station at which photometric readings were to be taken. A mile and a half away an airplane silhouette was erected, and three

some means of constant communication between the two parts of the testing squad which is composed of five active members, as follows:

(1) Lamp operator, who also records arc voltage and current at half-minute intervals.

(2) Beam trainer, who sees that the arc is properly focused and who directs the beam on the target and, by watching the arc, helps the operator in maintaining a normal crater.

(3) Communication man at searchlight, who in addition to keeping up communications, records the degree of flicker in the beam, the kind and time of hissing arc, and the outages.

(4) Photometer reader and communication man

(5) Data recorder for photometer only.

In addition to the above, there is the engineer of the power station and from one to six observers, depending on the type of the test.

The electrodes of the open-type searchlight are kept in the correct burning position by occasionally rotating both positive and negative. Any slight movement of the crater on the positive carbon is accompanied by a movement of the beam and there is no

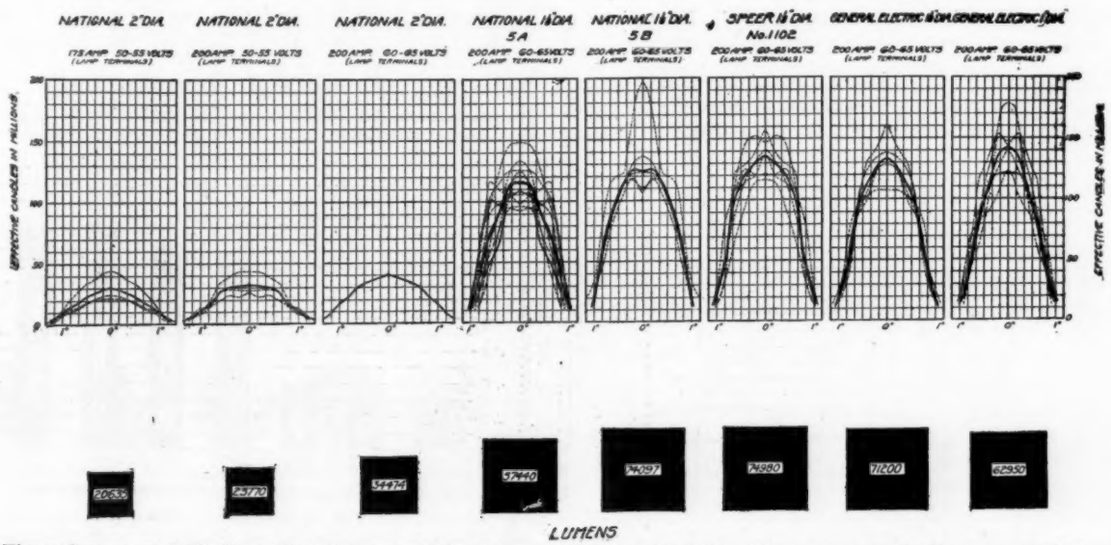


Fig. 7.—Three Curves at Left Show Pre-War Intensities from a 60-in. Searchlight—Five Curves at Right Show Preliminary Results with Five of the Most Promising Electrodes Developed During the War—Later Tests Were Restricted to the Three Best Out of These Five.

miles across the valley was located the big "vanishing" target mounted on the brow of a hill so that the sky formed the background. The searchlight station, power house, and photometric station were connected by a telephone line, while communication between the searchlights and vanishing target depended on a wireless telephone outfit similar to those used by the airplanes spotting for the artillery.

The beam of light reflected from a parabolic mirror has several peculiar features, the most important being the great distance to the point where the light in the beam has assumed an approximately final distribution. The light that strikes the center of the mirror has the greatest spread and forms the outside of the beam, and the light that strikes the rim of the mirror is most abundant in the center of the beam. Theoretically this crossing over process never ceases, but practically the light is in its final position at from 100 to 400 times the diameter of the mirror, depending upon the type of arc. These distances allow considerable atmospheric interference and also necessitate provision on the searchlight itself for keeping the arc as sharply in focus as is required in test work. For this reason, the beam scale shown in Figs. 5 and 6 was used as both a guide for the beam and as a means for observing and checking the beam width. The photometer was placed with its head at a hole in the center of the large white square near the right end of the scale. This zero mark on the scale was really a 6-ft. square hut with full equipment and accommodations for the photometer reader and the data man. The trainer would direct the beam so that the part in which measurements were required would come at the zero mark. The points of measurement were usually 0.2 of a degree apart, or two small divisions on the scale. The trainer watched one edge of the beam as he moved it across the target. The edges of the beam are more clearly defined than the center and as only one edge can be seen plainly at a time, the target was placed near the extreme right end of the scale. The left edge of the beam could then be moved over 4° 30′, if the beam were that wide. In general,

the testing was done across the horizontal center line of the beam, but a vertical scale was built so that occasional special tests in a vertical plane could be carried out.

The photometers were of the Weber portable type with a working range of 100,000 to 1, which is more than sufficient to cover the variations in intensity encountered. Thus, the ratio of the greatest intensity of the high-intensity arc to the lowest measured intensities of some of the smaller arcs was about 1000 to 1. The readings were in foot-candles at the face of the target, normal illumination, and the apparent intensity of the searchlight in candles was found by multiplying the illumination by the square of the distance, or 5,290,000.

It was realized from the first that the handicap of not knowing the atmospheric transmission would be fatal to much of the testing originally planned. Consequently, two instruments were designed and assembled at the laboratory for the measurement of this transmission. The smaller one, 6-in. diameter and 18-ft. focal length, was used during photometric work on the 2300-ft. target; and the larger one, 15-in. diameter and 30-ft. focal length, was used during the visibility tests on the three-mile target. These telephotometers each consisted of a simple double convex

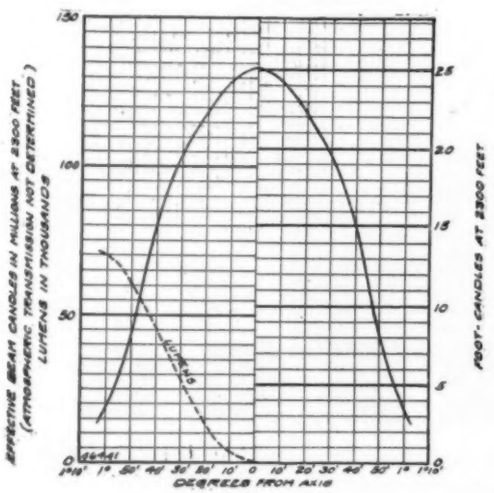

EFFECTIVE BEAM CANDLES IN MILLIONS AT 2300 FEET (ATMOSPHERIC TRANSMISSION NOT DETERMINED)
LUMENS IN THOUSANDS
FOOT-CANDLES AT 2300 FEET
DEGREES FROM AXIS

Fig. 8.—Curves Showing Beam Intensities and Flux Values Obtained With a Certain Group of Similar Electrodes.

lens which formed an image of the target in the center of the Lummer-Brodhun cube of a portable photometer.

The instruments were first set up in the laboratory and directed against a block of magnesium of such size as to give an image similar in size to that of the target on the outdoor range. The brightness of the magnesium was then measured through the telescope and compared with measurements made directly at a few feet distance. This ratio gave a figure for the relative brightness of the image in the photometer field. When used on the range, the zero section of the beam scale was illuminated by an incandescent searchlight that was carefully adjusted and maintained constant during the test. At a given signal, the man at the telephotometer would take readings and the men at the target, who had an extra photometer for the purpose, would take brightness readings on the same surface. A comparison of the two figures for brightness so obtained would give the loss of light in the atmosphere from the target back to the telephotometer, and the photometric data of the searchlight on test could be corrected accordingly.

Telephotometer readings were usually taken at the beginning of each night's work, at 11 o'clock, and at 2 a. m. just before quitting. A curve of time against transmission was drawn for each night, and the various tests were then located on this curve and given the proper correction.

The selection of electrodes for the open-type searchlight involved testing a large number of makes and mixtures before the final choice could be made. Three companies, the Speer Carbon Co., the National Carbon Co., and the General Electric Co., were actively engaged in making experimental mixtures that were tested out and reported on so that the chemists of the three companies were kept posted on both their own electrodes and those of the other two. Frequent meetings of the three chemists were held at the laboratory, where the test data and carbon stubs were inspected and these led to an extremely rapid development in the art of making better electrodes. It was this part of the work with which Mr. Ryan identified himself most closely, and it was his original specifications for sizes and currents that gave the development of carbons its flying start toward success.

Fig. 7 gives the total data of the tests on eight

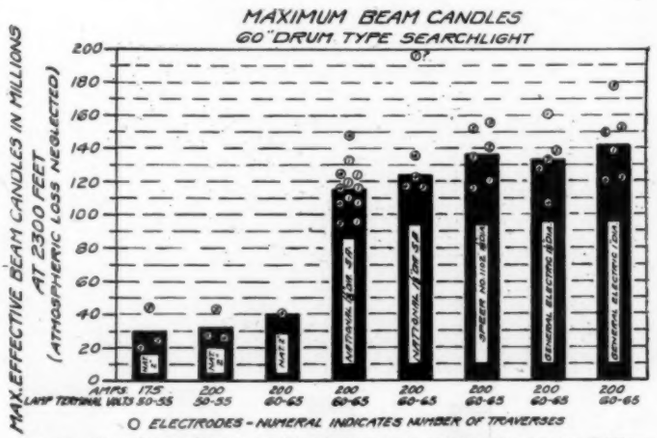

MAXIMUM BEAM CANDLES
60" DRUM TYPE SEARCHLIGHT
MAX. EFFECTIVE BEAM CANDLES IN MILLIONS AT 2300 FEET (ATMOSPHERIC LOSS NEGLECTED)
AMPS.
LAMP TERMINAL VOLTS
O ELECTRODES - NUMERAL INDICATES NUMBER OF TRAVERSES

Fig. 9.—Graphical Study of Maximum Intensities Given by Different Electrodes—Scattering of the Spots Indicates the Variations Encountered Between Individual Electrodes of the Same Mix.

carbons of the same mixture, including curves of the beam characteristics as determined by 17 separate traverses of the beam.

There are three prime requirements to be met by carbons for anti-aircraft searchlights. These are: High luminous efficiency, steadiness and uniformity of burning, and quietness. The first is the easiest to meet and the last is the hardest. Luminous efficiency and quietness (that is, freedom from hissing) seem to be opposite characteristics, and to obtain one without sacrificing the other is often difficult. The electrodes now made surpass the best pre-war carbons in all three features; and the development of carbons for greatly increased currents is still under way and holds great promise for the future.

The so-called disappearing target consisted of a strip of canvas 13 ft. wide and 300 ft. long. This was wound on two spools leaving exposed a section 13 ft. long. This 13-ft. section constituted the target on which visibility tests were made. The canvas was held high in the air so that the sky formed its background, and to this extent at least it resembled an airplane, and its distance from the searchlight, three

miles, represents a common "pick up" distance for airplanes. One end section of the canvas was painted with a good white diffusing paint having a reflection coefficient of 0.670. The second section was white with a number of fine black stripes, reducing the average coefficient to 0.532. The third section had wider black stripes and a coefficient of 0.423. The fourth had a coefficient of 0.335 or just one-half that of the first section. This geometric series, which reduces the coefficient by half every three steps, was continued until the last target was entirely black. The black and white markings were not visible at three miles, and to the observer the target grew dimmer and dimmer as it was moved toward the black end.

This target was used both as a disappearing and as a reappearing object. Starting with a white target, the canvas was rolled toward the black end. To the observers the target became gradually dimmer and dimmer until it finally disappeared. The disappearing point is not sharply defined, principally on account of the normal variations in the intensity of the beam. While the target was still fairly bright and distinct it would momentarily disappear during a period of low crater brilliancy. These periods of invisibility became longer as the target became a darker gray, until finally the target could be seen only during short periods of high crater brilliancy, and then came total invisibility.

The observers, who occupied various positions about the searchlight and whose watches had previ-

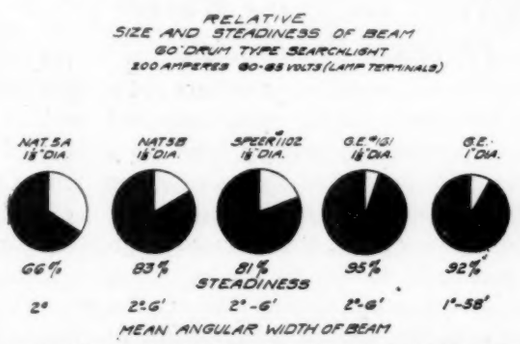


Fig. 10.—Holding a Searchlight Beam on a Swiftly Maneuvering Plane Requires Alertness and Quick Action for Which a Wide, Steady Beam Is a Great Help—The Above Shaded Areas Are a Measure of the Beam's Holding Power.

ously been set to agree with that of the target operator, recorded

(a) Time of first momentary disappearance,
(b) Time of disappearance half the time,
(c) Time of final disappearance.

The curtain was then wound in the opposite direction and the observers recorded

(d) Time of first appearance,
(e) Time of visibility half the time,
(f) Time of permanent visibility.

These records were then compared with the log of the target and the various sections identified. This test repeated with different searchlights gives a means of comparing their revealing power. It is worthy of notice that the revealing power, or working range under fixed conditions, increases much less rapidly than the beam intensity.

It is one of the unfortunate peculiarities of a searchlight that the beam itself often forms a most effective concealment for the target. The beam appears as a bright blue-tinted shaft of light, and this illuminated space forms a curtain in front of the objects under observation. In the vanishing-target tests the beam maintained its brightness and the target grew dimmer. At the vanishing point it may have had a fair degree of brightness, but not enough to make it visible in the body of the beam. This condition made it highly desirable to have another means of controlling the disappearing point of the target. An obvious

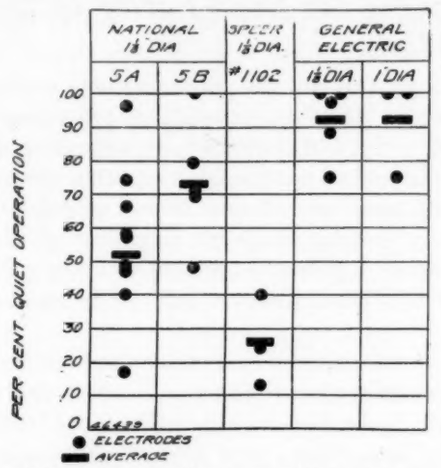


Fig. 11.—Quietness of Operation Is Essential When the Operator Has to Listen for Shouted Orders—Many Electrodes of Good Efficiency Were Discarded Because of Hissing—Such Noises Also Interfered Greatly with the Listening Devices Auxiliary to the Searchlight Equipment.

way of doing this would be to decrease the intensity of the searchlight until the target was lost. It is not practicable to alter the intensity of a searchlight without altering its color or beam width. The same result may be obtained by cutting down the light from target and beam as it enters the observer's eye. This was done at the range by having the observer look through the blades of a rapidly rotating sectored disk. The eye slit slid along a scale that told the degree to which the light was diminished. Thus, if the target was found to be just visible at 0.20 on the transmission scale of the disk, it indicated that a projector of one-fifth the intensity would show the target under the given conditions of test.

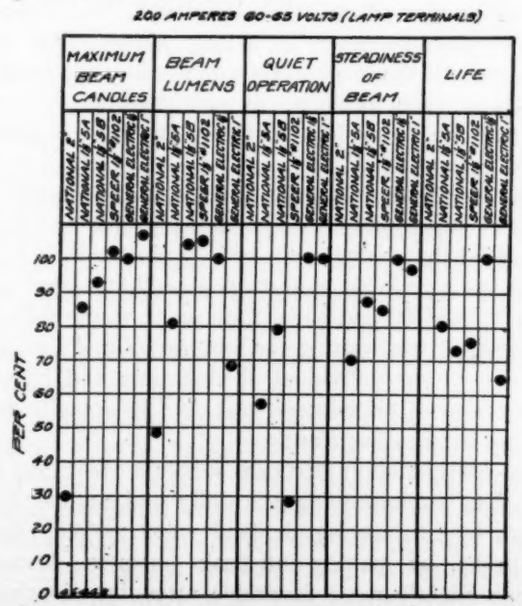


Fig. 12.—General Graphic Summary of Tests—This Form of Final Record Is a Great Help in Getting a Properly Balanced View of All Factors.

Editorial Comment

Improving the Load-Factor in Coal Mining

AS a general rule the public has only a very vague notion of all the conditions prevailing in any industry, and it is not until something develops to focus attention upon some particular industry that the actual facts regarding it bcome generally known. This truth is being borne out in the intensified study now directed on the coal-mining industry as the result of the widespread strike of bituminous coal miners.

One of the main contentions of the miners is that in the summer, when conditions for work in the mines are most favorable, they actually are called on to work but two or three days a week, whereas in winter they must work seven days a week. They insist on an evening up of their work to five days a week throughout the year. The mine owners, on the other hand, reply that they would gladly bring this about if the public would spread out its coal purchases more evenly during the year. Storage of coal on a large scale at the mines is said to be out of the question Much money has been spent in trying to educate the public to order its winter supply of coal during the spring or summer months, but little has yet been accomplished in this direction.

The electrical central-station industry was the first to recognize that a spreading out of the demand brought about important economies and electrical men have for a great many years been working for improvement of the load-factor in electrical supply. In other lines of business, while the desirability of steady orders has frequently been appreciated, little has actually been done to make a systematic study of it and adopt such measures as will improve the load-factor in the respective business. In the coal-mining industry the conditions just cited evidently call for an improvement in the load-factor. This would involve a change in the habits of the people and many are afraid that human nature is against this, because people as a rule do not want something until they actually need it and then they want it very badly. Thoughts of coal during the summer offend the ordinary perspiring individual at that time and he puts off purchase of his winter's coal until he actually must start up his heating plant.

In central-station electrical supply a great deal has been done in improving the daily and annual load-factors by introducing demand rates to keep down the peaks, by making off-peak business desirable through slightly more favorable rates, by stimulating summer loads and by attracting other loads that fill the valleys of the daily and yearly load curves. In the coal business reductions in price per ton are offered during the spring and summer months, but evidently they are not large enough to attract purchases on a large scale at those times. It is now proposed to make a strong effort to secure lower freight rates on coal during the summer months. Whether this would suffice in stimulating purchases during the summer it is not easy to say, but the matter deserves serious study and earnest co-operative effort on the part of every one concerned in improving the annual load-factor in coal mining. We believe that much good will come from this not only to the miners, to the mine operators, to coal dealers, the railroads and all others concerned with the coal business, but also to the public generally because the more stabilized condition in every branch of the coal business should reduce the necessary margins now necessary and possibly lead to reduction in price or at least prevent or restrict further increases in price.

Electricity Helps the Worker to Increase Production

FOR many months past writers and public speakers have been urging upon industrial workers the importance of settling down to work and ensuring, with the aid of the more efficent means now at their disposal, a larger output. The needs of the world are very large, and the need of greater financial and economic stability on the part of some great nations is even more pressing than are the requirements of peoples that cannot manufacture for themselves.

It has been stated over and over again that a special kind of propaganda movement suited to the prevailing spirit and conditions must be promoted in order to expedite the return to full industrial activity through the better understanding of the situation on the part of the people. It is said that it has always been one of the serious questions after there has been a war, how to get the people back to the ways of peace and every-day occupation without delay. After the late great war in which half the world has been compelled to change its ways, the problem is necessarily a more serious one than ever before. It is one thing to change over from war production to commercial industry in a factory; it is quite another, and a more difficult one, to change the mind and disposition or intention of millions of men and women. It is proving to be of little service for public men, however exalted, in England to urge British workmen to work harder and produce more in order that the nation may keep off the Road to Ruin. What is likely to be more successful is to show them that by the better means that have been placed at their disposal during

the war, by the use of modern and efficient equipment, and by the fullest possible use of electric power, they will be able to increase their output of work and manufactures without greater strain than in the past. References to Road to Ruin do not move them in many cases, but the other line of argument makes an appeal to the imagination and will produce quicker results.

The situation has created an excellent opportunity for electrical propaganda, but unfortunately public men and those who have the ear of the people are not quite so well qualified as they might be to handle the great national and personal aspects of electrical questions. In England such subjects have never seemed to appeal to legislators as suitable themes wherewith to interest their audiences, but there is a change in progress at last. The nationalization of electric power supply, by being a plank in the platform of the government now in office, has done something to induce the change. Mr. Lloyd George has referred to the subject once or twice recently, and others are now following suit. One of the best speeches of the kind was delivered recently by Mr. C. A. McCurdy, parliamentary secretary to the food controller. We quote some extracts from this address elsewhere in this issue. It would seem opportune for our public men in America to take a similarly progressive view of the potentialities as to production increase through greater use of electric power. No time should be lost in bringing the matter to their attention.

Air Supply to the Boiler Room

IN THE production of steam in power plants, air, fuel and water are the raw materials employed. Air is the bulkiest raw material handled by the power plant, and a greater weight of air is handled than any other raw material that goes into the conversion of the latent chemical energy of coal into the thermal energy of steam.

The evaporation of water per pound of coal varies from, perhaps, 4 to somewhat above 10 lbs. in the large modern plant. The amount of air required for the combustion of coal, likewise, varies quite widely. Theoretically, about 12 lbs. of air per pound of coal are required for complete combustion. In practice, the excess air may and often does attain 300 per cent, so that in practice the air per pound of coal may vary from 18 to 48 lbs. per pound of coal. Upon this basis it can be readily seen that the weight of air handled always exceeds from 12 to 48 times the weight of coal consumed, and even at the highest evaporation of water per pound of coal exceeds the weight of water evaporated.

In the utilization of the steam, however, in contradistinction to the production of steam, a greater weight of water is handled for condensing purposes than of air for combustion. And, incidentally, this water carries away to waste about 60 per cent of the heat obtained from the coal. The amount of circulating water used depends, of course, upon the vacuum obtained, the temperature difference of the cooling water and condensate. For low vacuua and cold water, the weight of cooling water handled may be less than that of the air required for combustion. But for vacuua above 29 ins., referred to a 30-in. barometer, and temperature of cooling water above 40 deg., the weight of the condensing water will be equal to and will usually exceed the weight of air needed for combustion.

That a greater weight and volume of air than coal or water is handled in producing steam is a fact that should be borne in mind in laying out a power plant and in operating it. At this time of year especially it is well to remember the large amount of air required for combustion, for sometime and somehow this air must come from outdoors. With cold days and colder nights, windows and doors are closed for the comfort of the men, and absence of a definite entrance for the air may result in operating difficulties and lowered efficiencies.

It might seem that so long as air gets under the grate and thence through the fuel bed, it matters little how it gets there. But not so. With windows and doors closed and the free entry of air hindered, a partial vacuum may be created in the station, reducing the effective draft, which in turn affects the combustion rate and efficiency, ability to maintain steaming rates, tending to create smoke and taxing stack or blowers. And then the temperature of the ingoing air to the fuel bed is a factor in furnace temperatures. Cold air only lowers the furnace temperature while air taken into the boiler room through the roof or warmed by the boiler room or losses of turbogenerators not only adds to the comfort of the men but may be transferred from the debit to the credit side of the ledger by lowering combustion losses.

Comfort of the men in the boiler room is almost as important a factor as the air furnished the fire. Both can be best served when the air supply is given as much attention as the coal and water-handling systems. Too many power plants suffer from insufficient air; too many stacks are taxed because of closed doors and windows during the cold weather. The fires in too many boiler rooms are partly asphyxiated because no proper provision for incoming air has been made. And the reason for these things is not because it has been overlooked that air is one of the three raw materials required in steam making by fuel, but because the vast volume and heavy weight involved are not fully appreciated.

The air-supply system, like the coal and water-handling systems, needs deliberate consideration and wise provision unless the performance of the furnaces is to be influenced in the interests of the comfort of the boiler-room force when the cold weather comes. Plant layout cannot now very well be changed, obviously, but the effect upon plant performance of closing all doors and windows and other sources of influx for air can be borne in mind.

Current Events

Jovian Order to Be Revived—Power Economy Conference to Promote Fuel Conservation — Drafting of Safety Codes

N. E. L. A. COMMITTEE TO AID UTILITIES GET COAL.

National Committee on Electric Service Revived to Co-operate With Government as to Coal Needs of Central-Station Companies.

John W. Lieb and George Elliott, chairman and scretary, respectively, of a special committee representing the electric light and power companies affiliated with the National Electric Light Association, have gone to Washington to co-operate with Director-general Hines and Fuel Adminstrator Garfield regarding the maintenance of fuel supply to public utility and related companies during the strike.

M. H. Aylesworth, operating manager of the association, said the committee's functions would be similar to those which were exercised by the National Committee on Gas and Electric Service during the war, in helping to conserve coal and to allocate the supply. A number of light and power companies, Mr. Aylesworth said, had advised him that they were already facing a fuel shortage and, in some instances, higher prices were being demanded for coal.

The committee will endeavor to keep every plant in operation by obtaining for it the required amount of fuel.

JOVIAN ORDER REJUVENATED AT CHICAGO CONVENTION.

Measures Adopted That Will Revive Interest and Bring Back Old Members—A. J. Binz Elected Jupiter.

Voting unanimously to reduce annual dues to $2, to eliminate all existing commercial features and to function solely as a fraternal and social body, the Jovian Order in annual convention at the Hotel Sherman, Chicago, Nov. 5, took steps that practically assures it of renewed interest and activity. Preceding this action, Arthur J. Binz and Ell C. Bennett generously agreed to underwrite the present indebtedness of the Order, so that the money received during the current Jovian year may be used to pay operating expenses. Any surplus after all expenses are paid will be used to apply against the past indebtedness, but even if there is no surplus at the end of the year the Order will be clear of debt.

Another measure adopted unanimously that will be of considerable importance in reviving interest provides that any man heretofore affiliated with the Jovian Order can by the payment of $2 for the current year's dues be placed in good standing regardless of his past indebtedness or his having previously resigned. It was the consensus of opinion that this action would insure the return of a great many Jovians who dropped out or failed to pay dues during the war.

The convention was scheduled for two days, but the work arranged was carried out so harmoniously that it was found possible to complete the program at the end of the first day. Jupiter L. O. Ripley presided at the two sessions, assisted by Mercury Bennett. The report of Jupiter's cabinet, which held a meeting on Nov. 4, was presented and embodied the recommendations already mentioned, which were unanimously passed with the exception of a recommendation to remove the central office from St. Louis to Texas. This recommendation was not pressed because of the action of Messrs. Binz and Bennett agreeing to underwrite the indebtedness of the Order providing the central office remained in St. Louis.

The election of officers resulted in Arthur J. Binz, Dallas, Tex., being elected Jupiter; Ell C. Bennett, St. Louis, Mercury; J. H. Betz, New York, W. R. Herstein, Memphis, and William Hand, Kansas City, members of Jupiter's cabinet. Upon motion of Mr. Bennett it was voted that Mercury serve without compensation.

In connection with the reduction of dues to $2, it was provided that such dues be payable directly to the central office. It was also voted to retain the insurance feature, which permits Jovians to obtain insurance at reduced rates.

NEW YORK ELECTRICAL SOCIETY AND AUTOMOTIVE ENGINEERS MEET.

Army Officers Describe the Remarkable Work of the Motor Transport Corps with the American Expeditionary Forces in France.

A joint meeting of the New York Electrical Society and the Metropolitan Section of the Society of Automotive Engineers was held in New York City on Oct. 30. The program consisted of a lecture by Lieut.-Col. Kingsley G. Martin, chief transport officer of Base Section 1, A. E. F., and a discussion by Lieut.-Col. Arthur J. Slade, of the Motor Transport Corps, on the motorization of the world's traffic. Colonel Martin revealed the experiences of the Transport Corps during the war, the accomplishments of the motor truck in the war emergency, and, finally, the impressions created by the American car in the minds of foreigners. He alluded to the relation between electrical development and the development of the motor car and showed that the successful operation of a motor car like that of so many other mechanical devices, depends upon the successful functioning of electrical apparatus.

Nearly all motor vehicles used by the expeditionary forces were shipped abroad in a knocked-down condition and were assembled at bases established in various parts of France. The amount of assembly work required per vehicle increased as the duration of the war increased, because of the tendency to ship abroad the separate parts of the cars collected in crates. Even the bodies were shipped knocked down, the metal covering being merely stamped in shape, the wood parts fashioned, and the upholstering material

in bolts. Some disorganization was caused at one time because a shipment of parts failed to contain tacks for the upholsterers.

The Motor Transport Corps was sent to France without equipment and instructed to assemble and repair the army's cars and trucks. The officers negotiated for land at the bases and began work when the right to use the land was acquired. Plans of assembly buildings were drawn so that the work could be prosecuted exactly as it is prosecuted in the most successful automobile plants in the United States. A chassis started down an inclined track at one end of a building and arrived a complete car at the other end.

Buildings for barracks and other purposes could not be erected until shipments arrived on account of the fact that the men had no building material. The crates in which the cars arrived, however, solved the building material program. From these crates the men constructed the only buildings in the bases. They built their own hoists, derricks, and shops, and made many of their own tools. They set up their own electric light plants and installed their own lighting equipment. They improvised prime movers by driving their dynamos by means of engines salvaged from disabled cars.

The wholesale production of cars was the marvel of the French people. Before 1917, European cars generally were made to order to suit the fancy of the purchaser, who was willing to wait several months for delivery. One of the principal influences that this country exerted on the actions of the Europeans was to change their method of producing manufactured goods. The hand-made system in French industry was replaced in many places by the system of quantity production which was introduced by the Motor Transport Corps. The largest French cities never had traffic control before the American army trucks arrived. The size of the army trains can be judged by the fact that, to fuel a single train, two five-gallon gasoline pumps operated continuously during a 43-hour interval.

WESTERN SOCIETY OF ENGINEERS TO BROADEN ITS ACTIVITIES.

Plans for More Intensive and Numerous Meetings, More Frequent Inspection Trips, New Sections, More Committees and Greater Service to Members.

As the result of the recent fiftieth anniversary membership campaign of the Western Society of Engineers, during which an effort was made to increase the membership to about 2000, a total of 2096 applications were received, thus increasing the membership to almost three times what it was before the campaign. The success of this campaign led to a general meeting of the society, held in its rooms in Chicago on Nov. 3, at which plans for the future of the society were freely discussed.

Amendments to the present constitution were submitted, changing the fiscal year to begin hereafter on June 1, instead of corresponding with the calendar year. The idea of this was to bring the change of administration during the summer dull season and cause less interference with the year's business program thereby. These changes were approved by the meeting and will be submitted to letter ballot of the members.

E. T. Howson, chairman of the Development Committee, presented a general report of the work done by this committee so far in discussing plans for expanding the work of the society and increasing its value to the membership. Much study has been given to this matter, especially in view of the very large increase in membership as the result of the campaign referred to. The committee submitted various suggestions for discussion and wished to get the sentiment of the meeting thereon.

As regards the time of holding the meetings, it was urged that the meetings convene earlier in the evening so as to permit members living in the suburbs and cities near Chicago to reach home in good time; the general sentiment was that the meetings should begin promptly at 7 p. m., and terminate not later than 9:30.

It was proposed to have, aside from the regular weekly or semi-weekly evening meetings, occasional luncheon meetings, these to be devoted largely to civic and nontechnical subjects, but which engineers should keep closely posted on. This suggestion was indorsed by many speakers who thought that one such a meeting a month would be very valuable, not only in broadening the knowledge of engineers, but in enabling them to meet socially more frequently.

Secretary E. S. Nethercut spoke about the library service of the society, which it is hoped to extend. Classification and indexing of the books has been carried on and this cataloging should be completed in the near future. There is considerable call on the librarian for furnishing special bibliographies on a considerable range of technical subjects and the librarian is co-operating with other libraries in Chicago on this matter. It was suggested that if enough members would desire it the rooms of the society would be kept open in the evenings. On motion of C. W. PenDell, this will be tried out for some 90 days and each notice of a meeting will carry mention of the fact that the reading rooms and library are open in the evenings.

Conducting more frequent inspection trips and excursions was suggested and this met with hearty approval. It was pointed out by a number of speakers that such inspections, given about once a month, should include not only the most important engineering works in and near Chicago, but also interesting industrial plants, public buildings, etc.

The society now has five sections devoted to electrical engineering, mechanical engineering, bridge and structural engineering, sanitary, hydraulic and municipal engineering and gas engineering. Three new sections have been authorized as follows: Electrical communication, industrial engineering and railroad engineering. Several speakers advocated the formation of still other sections, devoted to chemical engineering, power-plant engineering and public affairs.

An extension of the committee work was also discussed and among the suggestions made was that a committee be organized to gather data from construction projects involving deep foundations to secure definite information as to the depth of rock in different sections of the city. Another committee suggested was one to keep posted on proposed city ordinances involving engineering matters; another one that may be organized should investigate accidents in engineering structures; still another may draft standard contract forms for construction work.

The Committee on Program and Publications reported that programs for the remainder of the year have been practically completed and the prospects are very satisfactory for having a very interesting series of meetings throughout the coming season.

Fuel Conservation Comes Nearer as Permanent Bureau Is Formed

International Power Economy Conference Establishes Bureau to Collect and Circulate Information of Plant Performance at Chicago Convention

WITH the bituminous miners' coal strike looming as a certainty, the second International Power Economy Conference assembled in Chicago at the rooms of the Western Society of Engineers, October 30 and 31. The purpose of this meeting was to discuss the fuel situation present and prospective, to review progress made since the previous meeting and to formulate plans for promoting a permanent organization after listening to the reports of the Executive Committee and other committees.

Vice-chairman A. A. Gray in calling the meeting to order reviewed the past work of the conference, the need for carrying on and perpetuating the accomplishments of the Fuel Administration, and dwelt upon the threatened coal strike that would start before the conference terminated. Mr. Gray then stated what the Conference had done in connection with the Bureau of Mines toward assisting in perpetuating the work of the Fuel Administration, telling of interviews at Washington with Dr. Van H. Manning, director of that Bureau. Dr. Manning strongly endorses an organization that aims to co-operate with the Bureau of Mines and improve fuel economy and transportation facilities by inspection and supervision of coal at the mines. The prominent part taken by David Moffat Myers toward fuel conservation, by his work in the Fuel Administration and as a consulting engineer was dwelt upon by Mr. Gray, who then told of Mr. Myers' suggested program for carrying on and enlarging upon the work of the Fuel Administration. Unfortunately this program, while very thorough and desirable, was so comprehensive that there seemed little hope of having it acted upon by Congress at this session, due to its chaotic conditions and frenzied attempt to economize and cut expenditures.

C. A. Tupper, chairman, who then assumed charge of the meeting, said he was convinced that the present time offered a real opportunity for the manufacturers of power-plant apparatus to render a patriotic service. The looming coal strike and the possibility of similar conditions to those existing during the war strongly emphasized the need for such a body as was gathered together in the cause of making fuel economy permanent. Everyone should stand solidly behind the Government, regardless of politics and affiliations, during whatever complications lay ahead. The conference must decide for itself whether it should be a permanent organization or not, and this can be done only when everyone does his bit instead of "letting George do it." Mr. Tupper then explained the vast opportunity to serve the public and conserve fuel by education and development of public opinion.

The report of F. A. Moreland, chairman, Committee to Co-operate with the Fuel Administration, was thereupon presented.

Mr. Moreland told of the manner in which the Bureau of Mines had taken over the work of the Fuel Administration and gave in more detail the suggested program drawn up by David Moffat Myers, advisory engineer, Fuel Administration, and of the proposed inspection of coal at the mine by the Bureau of Mines, including the method by which coal would be sold upon a heat-unit basis and coal operators required to rate their coal accordingly to a definite set of standards under supervision at coal-sampling stations maintained by the Bureau throughout the country in proximity to the coal mines. As Mr. Myers' program would require not less than $1,000,000 appropriation, the first year, there would be little immediate chance to obtain any such amount from Congress. Meanwhile the Fuel Administration has been inactive, while the Bureau of Mines is not able to carry on the work for lack of authority to do so and from the fact that the Fuel Administration is still in existence. The big fuel saving brought about by the Fuel Administration in a short time and before it got working steadily augurs well for some similar body to encourage and carry on the work.

Urgency of Coal Conservation.

Joseph Harrington, former administrative engineer for Illinois, Fuel Administration, then said the fuel situation was really critical. The demand for fuel and labor-saving equipment today was greater than ever before. Practically every manufacturer of such equipment has never been busier and never was the opportunity and possibilities of co-operation for the interests of fuel saving more promising than now. With a coal strike virtually under way, whatever the result, higher coal costs seem inevitable, so that coal already deserves to be classed as an expensive commodity. Coal saving is not a matter of choice, but one of necessity today, and the public, as the ultimate consumer, is realizing that fact. The sum total is that more efficient use of coal is compulsory and wasteful methods will not be tolerated indefinitely.

The public is awakening to the situation through force of circumstances. It is being educated, and now is the time for such a body as represented at the conference to serve the country as a whole, and themselves also, by spreading the gospel of fuel saving. So long as a manufacturer produces equipment that serves a good purpose—and saving coal is prima facie an excellent object—it is to the interests of the public and nation as a whole that such equipment be used, and the fact that the manufacturer profits by its use is merely incidental. If all the manufacturers of power-plant equipment get together and boost the game by educating the public through publicity as to the need for saving coal and how best to save it by consuming it economically, all will be the gainers.

Mr. Myers' Program for Continued Fuel Conservation.

David Moffat Myers then outlined the program he had submitted for the continuation and extended scope of the work formerly carried on by the

Fuel Administration, if taken up by the Bureau of Mines. He said while it may be a crime to waste coal, Congress will only take cognizance of the matter in times of peace when public opinion is roused. The men represented by the present conference can accomplish most by educating the public, so that through it Congress can be reached and influenced in the cause of fuel saving. The high cost of fuel has given the movement of fuel saving great incentive. It is quite possible to save as much as 100,000,000 tons of coal per year without curtailing manufactured products. Over 25,000,000 tons were actually saved by the Fuel Administration in the short time it was active, and this is only a beginning. Valued at $6 per ton, $600,000,000 saving in coal bills annually is a factor neither the public nor the Government can afford to ignore. It is a factor vitally affecting the cost of living. While shortage of apparatus and inability to obtain it made it necessary for the Fuel Administration to devote its energies to saving coal by improving operating knowledge and education, conditions are now such that apparatus can be obtained. The efficiency of any process is the product of machinery and men. Today fuel saving may be brought about to an even greater extent than during the war, since both men and machinery are obtainable. From this reasoning it is apparent that machinery or equipment must be considered by the Government in any national program for coal saving.

Mr. Myers told of mistakes in the use of equipment and the installation of the wrong equipment in the wrong place, pointing out that these things must be stopped if coal saving is to obtain upon a national scale. He looks forward to the time when state engineers or district engineers will be appointed by some body successor to the Fuel Administration for checking up plant designs and seeing that they conform to thermodynamic principles. He said that the time must come when ability to operate power plants will not merely involve a state or city license to indicate sufficient knowledge to keep wheels turning and prevent a boiler from blowing up, but will mean that the engineer possesses some knowledge of combustion and ability to save coal and money for his employer. An organization of manufacturers of power-plant equipment has a magnificent opportunity for serving the country, and if this service is rendered unselfishly such an organization should have immense success.

Mr. Tupper then enlarged upon certain phases of Mr. Myers' remarks, pointing out that the scientific knowledge of the manufacturers and engineers could be utilized to educate the public in the proper way, and he hoped the movement now started would increase in momentum and accomplish its good purpose. The movement had also to have moral support of the central-station industry and many other industries. The problem before the assembly was how best to carry out the work of educating plant operators in the ways of saving fuel.

A. L. Rice, managing editor, *Power Plant Engineering*, opened the discussion by telling of the need and possibilities of coal saving, as based upon his close contact with the power plant field. The quality and cost of coal is becoming an increasingly serious problem. The power-plant-equipment manufacturers can accomplish a noble work by acting in an advisory capacity, and by being more altruistic in teaching the public. Where the coal consumption of a large consumer is reduced as little as one per cent, tremendous good accrues to the public. Such savings to a small number of large consumers are equivalent to the coal used to warm many a town. The task undertaken should be to do altruistic work in educating the public, and not merely trying to build up business.

A. W. Patterson, of The Engineer Co., said the man who manufactures coal-saving equipment is doing a good thing, and that such men are best able to tell the general public how to save coal by the coordination of apparatus. In this he was joined by Mr. Moreland, who pointed out that the public as a whole goes to the manufacturers for practical and technical information and uses them much as consulting engineers. An organization of power-plant-equipment manufacturers can thus be of immense value to the coal-consuming public by the correlation of data and the dissemination of knowledge.

R. J. Stewart, of H. W. Johns-Manville Co., spoke of educating the chief engineers and consulting engineers, telling of his experiences of equipment and materials misapplied and the readiness usually shown for correction and information. Just such a purpose would be served by the organization of manufacturers of power-plant equipment who would educate and co-operate. Other speakers presented similar views.

Coal Zoning and Washing.

Opening the afternoon session, Mr. Tupper introduced Hans J. Meyer, former advisory engineer for Minnesota for the Fuel Administration, and a consulting engineer, who spoke on "Solid Fuels." He said waste occurs in mining, in transportation, in distribution and in utilization. Wastes of transportation offer a big field for the organization to work upon, and the zone system of coal distribution and utilization is one of the most important things accomplished by the Fuel Administration. There is no need for importing eastern coals in the West, for the vast deposits of Illinois and Iowa coals and western lignites can be used when the public is educated in their use. Use of lignites in Minnesota and contiguous territory alone would save more than 500,000 tons of coal a year and release 50,000 freight cars and thousands of locomotives. The movement of coal is an enormous tax upon the transportation system of the country, and only the zoning of coal will solve it. The supervision of fuels mined and used was advocated.

B. J. Roberts, chairman, Committee on Washing and Pulverizing Coal, then presented a report on the "Purification of Coal" in which it was shown that by washing much foreign matter could be eliminated. If done at the mine this would reduce freight and coal bills, conserve freight cars and in any case would eliminate many operating troubles due to clinker, fluxing of refractories, etc. By washing, many coals now considered worthless could be used, and the culm banks now seen around mines could be put to good use. The various methods of washing coals were covered, and the financial gain of so doing brought out. This paper was discussed by David Moffat Myers, Mr. Harrington, and Mr. Meyer, who all agreed that the large amount of foreign matter in coal worked hardship upon the consumer and taxed the railroads needlessly. It was emphasized that cleaning coals by washing and pulverizing offer solutions to the use of low-grade fuels, and thus extend the use of fuels within easy reach.

M. F. Newman, chairman of Committee on Water Purification, then presented his very able and concise report. This covered the choice and operation

of the various appurtenances, and the influence of scale upon absorption efficiency of boilers and condensers, the transformation of energy in the turbine, etc. He told of the effect of scale formation in pipe lines, economizers and boilers and the various causes and forms of incrustation, etc. The inertia of the average plant operator was deprecated and the importance of water purification emphasized as a factor in fuel economy. In his remarks Mr. Newman was supported by C. Kennicott who dwelt upon various phases of water purification.

Albert Goetz, chairman, Committee on Boiler Settings, then presented his report, in the discussion of which A. W. Knight elucidated upon the various losses through the brickwork and segregated them. He pointed out that, while comparatively small, the loss through the setting, about 4 to 6% of the total heat loss, can be reduced from 1 to 2% by simple methods.

The report of W. G. Williams, chairman, Committee on Oil Fuels, was then presented. This report covered the consumption of fuel oil and the situation as regards its increasing use and decreasing sources of supply. Statistics were presented that visualized the situation as it exists today. The various methods of producing gasoline and distillation and refining of oils were discussed briefly and a plea made for conservation by reducing needless wastes in producing and drilling and by more efficient methods of utilization. Two lines of action were suggested, the one the more rapid development and utilization of cracking distillation for which the automotive industry must be looked to for assistance; and to the central stations for the use of the fuel oil more efficiently. The report of the Committee on Lubricants was then presented by A. A. Gray.

General Discussion on Organization.

As time was late, discussion of these reports was passed over. Mr. Tupper asked for a general discussion upon the scope of the proposed organization and the best methods of going about their program for the guidance of the Committee on Organization. Mr. Harrington said the matter on hand was to decide what was to be done, what needed to be done and how it should be done. There was the matter of co-operation with the Fuel Administration and Bureau of Mines, there was the matter of educating the public, of the zoning of coal mined and used, and of supervising engineers, etc. J. M. Spitzglass said it was partly a matter of educating engineers of what to do to save coal and what is available in the way of machines and equipment for saving coal, but it was also a matter of telling the public about coal saving and how to accomplish. He promised his unqualified support of such a good movement and offered to do all in his power to further the work of the organization.

E. G. Bailey spoke out for a broad-gauged viewpoint and a concentrated effort as both necessary for success. He advocated that the Fuel Administration be revived rather than that its work be continued by a different body. He said four principal aspects of the situation must be considered. These concern the procedure, the consumer, the general public and posterity. The subject may be divided into two parts, the coal producer and the coal consumer, and between these two groups the Government and the engineering professions must step in if coal is to be saved to posterity. Once the public understanding is obtained, and its opinion aroused, it will back up such an organization as proposed. A. A. Gray and H. J. Gebhardt both spoke of the weight carried by the manufacturers of power-plant equipment and that this weight must be added to that of public opinion for co-operative effort. The engineers are the go-between and it is they to whom the public must look to tell them how to save coal. Mr. Gray said 85% of those present were manufacturers and they represented the opinion of the industry. J. D. Cunningham pointed out the strength in numbers, advocating that the Association of Commerce and the various enginering societies be asked to help the cause.

Mr. Myers spoke at length on the responsibility of the engineering profession to the public and also to themselves. The four national engineering societies can be of assistance as they extend their influence into industry as a whole. The proposed organization should co-operate and seek the assistance of these national engineering societies.

Others prominent in the proceedings were Joseph W. Hays, Joseph W. Hays Corp.; G. B. Burke, Sarco Co., Inc.; E. E. Lee, Vulcan Soot Cleaner Co.; F. R Wheeler, C. H. Wheeler Mfg. Co.; A. H. C. Dalley, consulting engineer, Locomotive Superheater, vice-president, Pulverized Fuel Equipment Corp.; A. W. Knight, Celite Products Co.; G. P. Dravo, Dravo Co.; G. W. Heald, Diamond Power Specialty Co.; W. A. Darrah, consulting engineer; O. R. McBride, Northern Equipment and Coppus Engineering Cos.; J. J. McNulta, Vacuum Ash & Soot Conveyor Co.; M. B. Skinner, M. B. Skinner Co.; C. C. Phelps, Uehling Instrument Co.; W. D. Dreiske; L. L. Shailer, Ehret Magnesia Mfg. Co.; W. D. Hess, Builders' Iron Foundry; C. E. Brainard, Brainard-Fairchild Engineering Co.; C. V. Frailey, Barber-Greene Co.; M. O. Haeger, Abell-Howe Co.

During the first day's meeting Mr. Tupper appointed the following as members of the Resolutions Committee to draw up a preamble as to the aims and organization of a permanent body: Joseph Harrington, James A. Brady Foundry Co., chairman; Hans J. Meyer, Chas. L. Pillsbury Co., consulting engineer; A. L. Rice, managing editor, *Power Plant Engineering;* A. W. Patterson, vice-president, The Engineer Co.; T. Wilson, western editor *Power;* M. F. Newman, manager, water purifying department, W. B. Scaife & Sons Co.; R. J. Stewart, H. W. Johns-Manville Co.; A. A. Gray, of A. A. Gray & Co.; Howard Ehrlich, managing editor, Electrical Review.

Friday Morning Session.

The Friday morning session was opened by C. A. Tupper in the chair. The first speaker was Francis W. Carrett, chairman, Committee on Recording Instruments, who in presenting his report stated that accurate recording instruments are proving immensely valuable in every industry by showing conditions and thereby enabling them to be improved and corrected and results to be sustained. He discussed in particular the instruments of the boiler room, pointing out that without them the combustion of coal must be a hit and miss process, since it is not possible to know what is being done or how it is being done. He spoke of co-operation between the instrument manufacturer and other manufacturers and also between them and the plant operators. Instruments can only tell what is going on and they must be interpreted and their interpretation properly applied if the highest return upon the investment is to accrue. Instruments are of

vital importance in the boiler room, and are one of the most powerful factors in power-plant efficiency. By preaching the value of instruments, by applying them correctly and educating the users in their workings and meanings much can be done to save coal and make instruments more useful and more widely used than they are at present.

Following this report, R. J. Stewart, chairman, then presented the report of the Committee on Insulation and Pipe Coverings, in which he dealt with insulating materials and their application, emphasizing the need for a better understanding of the requisites and economies of pipe coverings on the part of the operating and consulting engineers. He advocated closer understanding with plant operators and consulting engineers. The magnitude of the losses was then dwelt upon and instances given where costly pipe coverings had more than paid for themselves in 9½ months. The possibilities of an organization as proposed for educational purposes and as a clearing house of information and data appeared almost limitless. Both the reports by Mr. Carret and Mr. Stewart received considerable discussion.

L. A. Griffin, chairman, presented the report of the Committee on Ash Handling. In this report he took up the evolution of ash-conveying systems going on to point out that the labor situation existing makes mechanical handling practically compulsory. Various methods of handling non-combustible were given and the economies of the ash conveyor pointed out. One specific example of economy was given where a steam ash conveyor functioning for three 15-minute periods during the twenty-four hours was doing the work previously done by eight to twelve men. The future will necessitate mechanical ash-handling methods even more than is the case today. Mr. Griffin spoke forcibly in favor of a permanent organization to further the cause of fuel conservation, offering everything in his power toward making the organization an accomplished fact.

G. S. Carrick, Carrick Engineering Co., chairman, Committee on Combustion, spoke of combustion and the importance of educating firemen. Combustion requires not only men skilled in methods of combustion, but also apparatus and instruments for performing it and telling how it is being accomplished. The labor situation has created the need for automatic apparatus for maintaining high sustained and uniform performance, but these must be supplemented by man power of the right sort, and it is to help produce the right kind of man power by edcuation that the organization proposed can accomplish much. Both these papers received considerable discussion, mostly of a practical nature in the form of personal experiences in the boiler room.

After the presentation of the report of the Committee on Cooling and Condensing Systems, a general discussion ensued. Mr. Patterson emphasized the importance of co-ordinating the various apparatus and the relation existing between them. A better knowledge of individual pieces of equipment would enable a better and less expensive plant to be designed frequently. Each individual manufacturer should be called upon to furnish data and information on his speciality, and then the Educational Committee could analyze this and put it into proper form and sequence for general digestion and utilization. He went on further to give instances of saving due to the use of feed-water regulators, control equipment, instruments, etc. By instilling common sense into the boiler-room crews, between 50 and 75% of the operating troubles occurring today could be obviated. Many men spoke in the same strain, all agreeing upon the need for education and circulation of information.

Hans J. Meyer then presented the report of the Committee on Organization which had prepared the following statement:

RESOLUTIONS ADOPTED.

"The object of this conference is disinterested public service in the subject of conservation of fuel resources.

"We are initiating this movement because of our direct understanding of conditions and desire to convert to the public good our specialized knowledge of this subject.

"We having had direct and intimate acquaintance with the work and results of the Fuel Administration during the war, believe that the results accomplished were substantial and in the interest of the public at large and we, the International Power Economy Conference, advocate the continuance of the work of the administration through the Bureau of Mines, or suitable government agency.

"We are convinced that the losses are so widespread and ingrained that only governmental action will result in securing effective improvement.

"Serious waste occurs in mining, preparation, transportation and utilization of fuel, much of which is preventable. If prevented, a saving to the public will be made of $600,000,000 annually.

"We therefore unite for the purpose of bringing about the results stated in the preamble by means of the dissemination of information of this subject, which should lead to an awakening of public interest and create a demand by the public for governmental action. In furtherance of this object, we solicit the co-operation of the public as well as all civic and engineering bodies—and pledge ourselves to collect and distribute data on this subject as to the best means of accomplishing the economies sought.

"Resolved, That this Conference shall become an incorporated association with the usual officers and directors as soon as 100 representative firms shall become contributing members.

"There shall be appointed by the chairman an executive committee of ten which shall conduct the campaign for membership and draw up a constitution and by-laws for presentation to the next conference.

"Upon the election of the permanent officers, the executive committee shall be dissolved.

"The permanent officers and directors shall thereafter direct the affairs of the association as is usual in accordance with the constitution and by-laws adopted by the Conference."

Hans Meyer made a motion that the report of the Organization Committee be adopted and that the chairman appoint a new executive- committee to undertake the work suggested. The resolution was passed unanimously. A. A. Gray offered a vote of thanks for those manufacturers who had devoted so much time to the cause of the movement and those that had come many hundreds of miles for the same purpose. Mr. Stewart offered a rising vote of thanks to Mr. Tupper and his associates for the time and effort they had expended to bring the formation of an organization to such a promising stage. Both of these motions were unanimously adopted and the second annual session of the International Power Economy Conference adjourned.

REPORT OF BALLOTING ON INDUSTRIAL SAFETY CODES.

Bureau of Standards Issues Statement Showing That Interested Organizations Favor Preparation of Safety Codes Under Auspices of American Engineering Standards Committee.

A conference on Industrial Safety Codes was held at the Bureau of Standards on January 15, 1919, at which the best method of procedure in formulating such codes was considered and plans made for the co-operation of all organizations concerned therewith. A committee appointed at this conference and consisting of C. A. Adams, H. W. Forster and E. B. Rosa made a report on April 15, which was printed and distributed to all those attending the conference. This report gave a summary of the proceedings of the conference and submitted two plans, designated as Plan A and Plan B, for future procedure in the formulation of the industrial safety codes.

Plan A provided for the preparation of safety codes under the leadership of the Bureau of Standards with the co-operative effort of all interested organizations and under the general supervision of a large and representative conference committee.

Plan B provided for the preparation of the safety codes and other standards by appropriate sponsor bodies, but under the auspices and procedure of the American Engineering Standards Committee as enlarged under a revised constitution. Since then, the American Engineering Standards Committee has approved a revised constitution, and has submitted it to the five parent engineering societies and the three government department members for ratification as provided in the old constitution. Although the American Engineering Standards Committee will continue to be called a committee, and not an association as was first proposed, the revised constitution provides for the enlargement of its membership and sets forth the procedure by which other national organizations may join it. It is understood that a number of such associations will apply for membership at an early date. Further information concerning the conditions under which national associations may join and the annual dues which are paid by member bodies may be obtained by addressing the acting secretary, C. B. LePage, 29 West Thirty-Ninth street, New York City. It is confidently expected that favorable action will be taken by all members within a short time.

In conformity with the report of the committee above referred to, ballots were sent out for voting on Plan A or Plan B. Such ballots were sent to a designated list of federal bureaus, state commissions, municipal departments, technical associations, manufacturers' associations, utility associations, associations of government representatives, associations of insurance interests, safety and labor organizations.

The result of this ballot is as follows, the voting being by organizations rather than by individual delegates: For Plan A, 25 votes were cast. For Plan B, 60 votes. Of those voting for Plan A, less than one-half indicated a likelihood of joining the Standards Committee in case its reorganization is completed. Of those voting for Plan B, three-fourths looked forward to joining the committee. In other words, approximately 70% of the ballots cast favor Plan B and about 66% of the organizations voting would expect to join the enlarged and reorganized Standards Committee.

The distribution of the votes is shown in the following table:

BALLOTING ON INDUSTRIAL SAFETY CODES.

	For Plan A	For A and probably join	For Plan B	For B and probably join
Federal Bureaus	4	2	5	2
State Industrial Commissions	3	3	5	4
State Utility Commissions.	6	2	6	4
State Inspection and Rating Boards	0	0	4	3
Municipal Departments	0	0	2	2
Technical Associations	3	2	10	7
Manufacturers' Associations	3	0	12	10
Utility Associations	1	1	4	2
Associations of Government Representatives	2	1	2	1
Associations of Insurance Interests	0	0	6	6
Labor and Similar Organizations	3	0	0	0
Safety Organizations	0	0	4	4
Total	25	11	60	45

Total Vote 85
Join A. E. S. C. 56

It will be noted that the governmental bodies give a slight majority in favor of Plan B; that the engineering, utility and manufacturers' associations give a large majority on the same side, and that the insurance organizations are unanimously in favor of this plan. The two labor organizations voting favored Plan A. Most of the safety organizations favored Plan B. It is consequently evident that Plan B will secure the most general support and should be followed if the necessary conditions are fulfilled.

To further consider this matter and in order to make progress in the co-operative work necessary to formulate industrial safety codes, the Bureau of Standards is calling another conference to be held in Washington, D. C., probably on Dec. 5, 1919. It is intended at that time to consider the procedure which should be followed in further work on safety codes and the co-operation that can be secured among the engineering societies, government departments and other agencies that are actively concerned with safety work.

Formal invitations to attend this conference will be sent out in the near future together with a program of the subjects to be considered.

MILWAUKEE STREET-CAR CASE SETTLED BY COMMISSION.

Fares Raised, More Cars Ordered, Service to Be Improved and Accounting Revised As Result of Important Decision of Commission.

The Railroad Commission rendered a decision on Oct. 30 in the long drawn-out Milwaukee street-railway case. It grants the Milwaukee Electric Railway & Light Co. an increased fare, orders extensions of double transfer privileges, orders it to put into effect the wages, hours of service and working conditions as embodied in the decision of the State Board of Conciliation, orders the puting into service of 100 additional cars, establishes a single fare between certain suburban districts and orders sweeping changes in the company's methods in order to more properly reflect the actual operating costs. In the single-fare zone the cash fare will be 7 cents, 6 tickets for 35 cents or

18 tickets for $1. Children's fares are not changed. The Commission reserves jurisdiction in the matter of tickets in the hope that the revenue produced under this scheme will be such that within a short time it will be able to order an increase in the number of tickets sold for $1. In the suburban area a cash fare of 3 cents for each zone within a minimum of 6 cents is established. Suburban ticket rates are not changed. The company is ordered to submit within 15 days a scheme for the issuance of commutation tickets between South Milwaukee and the single-fare areas.

This decision involves four cases—the report of the Board of Conciliation establishing fair wages to employes which was rendered Sept. 17, 1919, the application by the company for revision of rates which was filed in July, 1919, investigation by the Railroad Commission of the necessity for double transfers which was started in January, 1919, and the original application of the company for increased fares which was started in 1915, and in which case several temporary decisions have already been rendered.

Auditing the company's monthly operating reports and estimating the amount of revenue required for operating expenses for the coming year, the Commission finds that the amounts charged by the company for certain operating expenses exceeds the reasonable allowance for these expenses by several hundred thousand dollars, and it finds that the company had not separated its expenditures and charged the proper amount to reserves and capital accounts. But even with this adjustment after making allowance for this deduction and adding the estimated cost of the increased wages ordered into effect, the Commission finds that additional revenue of between $850,000 and $900,000 would be needed for the coming year. The estimated increase in wages for the single fare and suburban area amounts to about $710,000.

In estimating the return on the investment the value of the Milwaukee company's system, exclusive of power-plant property, was found to be $16,145,534 on July 31, 1919. The Commission finds that there have been no excess earnings during the period beginning Aug. 23, 1912, under the rates of fare established by the Railroad Commission. The excess amounts which it is claimed should be applied to make up the operating deficits at the present time the Commission finds were earnings prior to Aug. 23, 1912, under rates provided by franchises which were lawful rates at that time; that these excessive earnings, if any, were legal earnings and are the property of the company to do with as it sees fit and that it can not be deprived of them without violation of the constitution of the United States; furthermore, to deprive the company of this surplus would be establishing a principle against public policy and against the interests of the riding public of the city of Milwaukee. It could only result in crippling the company financially, making it impossible to carry out the provisions of this order, including additional equipment for giving adequate service, and would interfere with other improvements which might be found necessary for serving the public in the future.

The Commission finds that the working men living in the Bay View district and employed in the manufacturing plants at Cudahy have been discriminated against by the zone system when the fares in this district are compared with those applicable to West Allis and some other suburban territories, and believes that this situation can be remedied by establishing a special rate to and from Cudahy depot from and into that territory south of Mitchell street known as the Bay View district which shall be applicable on special cars and trains during rush hours and has therefore ordered into effect for this special service the same rate of fare as applies to the single-fare area.

The company is also directed to make a study of economies that can be brought about through short routing and a development of traffic during the non-rush period with the idea of improving service conditions in the city. The Commission has repeatedly called attention to the necessity for more equipment on the city railway system. It felt it was not justified during the war period in ordering the company to enter into any activities which might interfere with war activities. However, under the present changed situation, new equipment to meet the present needs should be secured at the earliest possible time. The Commission's investigation shows a considerable shortage of cars on practically all lines in the city. The company is therefore ordered to provide at least 100 additional cars with a total seating capacity of 5000 to be placed in service from time to time, the complete equipment to be in service before Nov. 1, 1920.

In a memorandum attached to the decision the Commission discusses the advisability of establishing an automatic cost basis of fares within the single-fare and suburban areas of Milwaukee, by the operation of which fares would automatically decrease as operating expenses decreased. The Commission is of the opinion that in this way many of the problems connected with street-railway operation would be solved more easily and the regulation of fares put on an automatic basis.

IMPORTANCE OF ACOUSTICAL ENGINEERING IN INDUSTRIAL PLANTS.

Time and money saving are the two all important considerations upon which acoustical engineering will establish itself as one of the important sciences of industrial construction in future, Prof. Vladimir Karapetoff, head of the electrical engineering department of Cornell University, told members of the Cleveland Engineering Society and the Electrical League of Cleveland, in their joint meeting at Hotel Statler, Cleveland, Ohio, on Oct. 30.

Declaring that American industry must speed up production to the highest possible degree if we are to compete successfully with Europe for the world trade, Professor Karapetoff emphasized the necessity of making provisions in every factory for instant communication between responsible departmental heads. This is peculiarly the day of the expert; when infallible knowledge is imperative, quick decisions necessary, and every source of counsel must be ready to respond instantly. Delays in decision were never so costly. And with the possibility of a shortening of working hours in many lines the problem becomes all the more acute.

For the last year the professor has been engaged in research work in many different kinds of industrial plants with widely varying conditions. He has experimented with half a dozen systems of factory code calls, audible and visible. The possibilities of such a system were interestingly demonstrated as a feature of his talk, through the use of the klaxocator, an electrical code calling mechanism of the audible type. The appliance is entirely automatic, and when set for a certain code sounds the call simultaneously in every part of the plant, however large, and summoning the person wanted to the nearest telephone.

Commercial Practice

Increasing Production—Comparison of the Cost of Electric Service With Other Commodities—House-Wiring Activities

MAN, MACHINERY AND POWER TO INCREASE PRODUCTION.

British Parliamentary Official Urges Much More Extensive Use of Electricity to Stimulate Production.

Electric power engineers and specialists are recognizing that they have at hand a means for helping to satisfy one of the most urgent demands of the time—increased production. Through the more general use of electric power the limited outputs per workman due to sticking to manual methods can be greatly increased, efficiencies of plants and of departments can be improved, and present production capacities of existing plant facilities can be increased without expensive extensions or new construction. While these truths are being applied by all progressive American power companies, interesting corroboration of them comes to us from across the water through the following condensed report of an important address, for which we are indebted to our British correspondent.

C. A. McCurdy, parliamentary secretary to the British food controller, recently delivered an excellent appeal to British workmen to settle down to industry and produce more wealth as a means of securing the maintenance of the higher wages brought by the war.

"There are three things used in making wealth: men, machinery and motive power," said Mr. McCurdy. "If you want more wealth you have got to speed up either the men or the machinery, or supply more motive power. There is no other way. Don't expect impossibilities from the men. How about the machinery and the motive power? There you touch the heart of the problem. Machinery and motive power are the tools you give the worker for his business. Before the war the American worker was far better equipped in this respect than the British working man. He had in his factories on the average newer and better machinery, and he had 50% more motive power (steam power or electrical power) to help him in his task. We might double the efficiency and the output of British workmen by giving British industry cheap and abundant motive power.

"Every year we use in England 80,000,000 tons of coal as motive power to drive machinery to help the workers to produce the things we want. Man for man we use in industry half as much coal again as they do in America, but we do it so badly, so wastefully, that one ton of coal used to assist the worker in the United States gives him 50% more help, 50% more motive power, than 1½ tons used to assist the British worker. That ought to be put right. The Coal Conservation Committee during the war reported that our present consumption of coal for industrial purposes might be made to give at least three times the amount of power. That is one way of increasing production. Treble your motive power. More power means more output, and more output means higher wages.

"The motive power of the future will be electricity. What are we doing about that? We have 600 separate authorities at present generating electricity for public purposes, apart from all the private companies and firms that supply themselves. It is a wasteful, petty, parochial method of supply. Experts advise us that this country is losing $500,000,000 a year through failure to take advantage of electrical progress. . . . We know exactly what we want—centralized supply, abundant and cheap distribution of electricity in the interests of British trade. . . . We want cheap power brought to every town and village.

"Cheap power and efficient transport would revolutionize our agricultural industry. Science has achieved many marvels. It has opened for us in the depths of ocean and in the trackless mazes of the air new highways for the commerce of mankind. If the same genius and effort were applied to the soil of England there is an inexhaustible mine of wealth for our people. It cannot be worked out like coal. The more it is worked the better it becomes. In France, Italy, Germany and Sweden, electricity is being harnessed to the service of agriculture. From extensive power stations light overhead lines carry electricity to the farm. A trailing cable carries electricity to the plow. By electricity the chaff is cut, the corn is kibbled, the apples pressed for cider, the sheep are shorn, and the cows milked. The application of science to agriculture is only in its infancy, but to increase greatly our production of food it is only necessary to apply the knowledge we have already got."

MAP SHOWS ADVANTAGES OF TIEING CALIFORNIA SYSTEMS TOGETHER.

The Mt. Whitney Power & Electric Co., Visalia, Calif., has prepared a large relief map of central and southern California showing in distinctive colors the principal lines of the Mt. Whitney Power & Electric Co. and the Southern California Edison Co. as well as the location and capacities of all generating stations and the location of the principal substations of both companies.

This map is to be used in a demonstration of one of the many advantages accruing to each, but more especially to the Mt. Whitney Power & Electric Co., through the unified management of both companies, this advantage coming from the interconnection of the generating systems of the two companies and which permits of the Edison company using the surplus power of the Mt. Whitney company which in former years has gone to waste. It will be shown that, in the absence of any appreciable storage above the hydroelectric generating stations of the Mt. Whitney system, and the existence of Huntington Lake reservoir, with a capacity of 88,834 acre-feet above Big Creek power houses No. 1 and No. 2 of the Southern California Edison Co., all surplus power

generated in the Mt. Whitney plants can be and is sold to the Southern California Edison Co., thus enabling the latter company to reduce the quantity of water withdrawn from Huntington lake during such period. It will also be pointed out that with the lines of the two companies tied together and the generating stations of both companies operated as a single system, a continuous and ample supply of electric power to meet the growing demands in the Mt. Whitney territory is made possible.

DEMAND FOR HOUSE WIRING SHOWS IMPROVEMENT.

For the period from Jan. 1 to Sept. 30, this year, the total number of houses wired by the Public Service Co. of Northern Illinois and by contractors in its territory was 2247, a number much in excess of the figures for the same months of 1918 and 25% greater than the total reached during the corresponding period of 1917.

During the war the company found a marked disposition on the part of property owners to restrain all expenditures, but this year there has been a hearty desire to modernize their houses by the installation of electric service. It is noteworthy that in nearly half of the houses wired by the company this year the improvement was paid for in cash.

DECREASING COST OF ELECTRIC SERVICE SHOWN IN STRIKING MANNER.

Curves Circulated by Commonwealth Edison Co. Emphasize Low Relative Cost of Its Service.

That the cost of central-station service has shown a steady decrease year by year until the conditions created by the war brought the decrease to a standstill is quite generally appreciated by the electrical industry and a large number of the people. Likewise, everyone knows that practically all other costs of living have increased, they not even having stood still—as

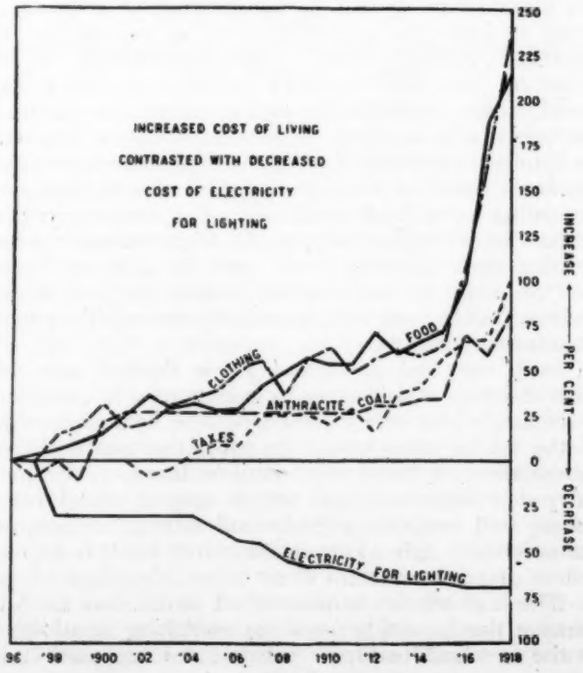


Fig. 1.

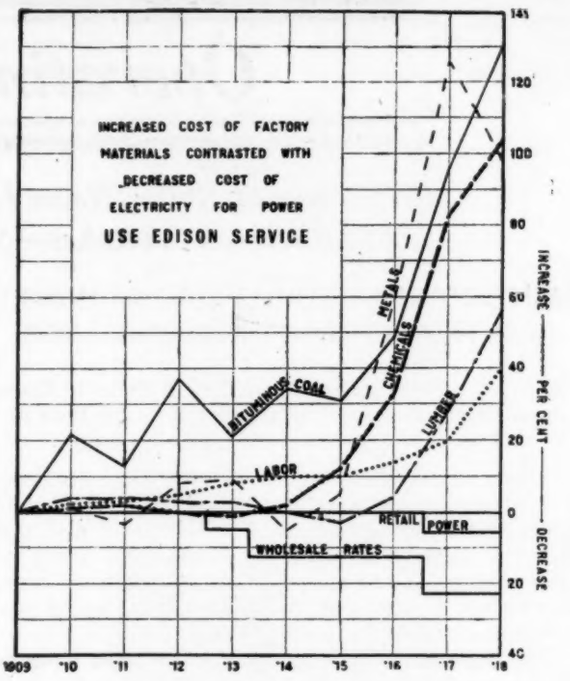


Fig. 2.

the cost of central-station service has done with many of the larger utilities.

During the electrical show in Chicago, the Commonwealth Edison Co. adopted a novel and striking method of bringing home to the local public and all those others who patronized the show the extent to which many of the items in the cost of living have increased in cost while the cost of "Edison" service has gone down steadily until the middle of the year 1916, since which time it has remained constant at the low level reached. The curves distributed among the visitors to the Chicago Electrical Show, typified central-station service to the hundreds visiting the exhibition, and to this extent benefited other utilities.

The accompanying curves, developed by the Commonwealth Edison Co., bring out in a striking manner the relative cost increases—decreases in the cost of central-station service only—that have come about since 1909.

In Fig. 1 are shown curves illustrating the increases in cost of clothing, food, coal and taxes during the last twenty-three years, and the decreases in the cost of electricity during the same period. In Fig. 2, the curves show respectively, the increases in cost of factory materials—coal, metals, lumber, chemicals and labor—during the last ten years and the decreased cost of electricity from Edison service for the corresponding period.

NEW HOUSE-WIRING RECORD ESTABLISHED IN MINNEAPOLIS.

Indicating the current prosperity of the people in Minneapolis comes an item from the Northern States Power Co. to the effect that during the month of September one already-built house was wired for electricity every 45 minutes during working hours. The average number of old houses wired per day during September was 23, the total for the month being 597, an increase of 9% over the largest house-wiring month in the experience of the company. As compared with 1918, nearly double the number of houses are being wired this fall.

Operating Practice

Maintaining Boiler-Room Instruments—Advantages of Air and Oil-Break Switches—Special Transformer Mountings

MAINTENANCE OF BOILER-ROOM INSTRUMENTS AND PLANT PERFORMANCE.

Experience of One Power Plant Proves Value of Instrument Maintenance and of Routine Coal Analysis in Improved Operation and Fuel Economy.

Many power plants install boiler-room instruments as a means of reducing their fuel bills by enabling higher operating economies to be obtained, and then, after the novelty of these appliances has worn off, ignore them. The result is that the expected economies do not accrue, and the savings that should occur do not materialize.

Speaking before the International Power Economy Conference held in Chicago October 30 and 31, A. W. Patterson, the Engineer Co., stated he was frequently discovering almost unbelievable things going on in power plants, sometimes through ignorance and sometimes through inaccuracy of instruments.

In one instance especially, of a plant consuming several hundred thousand dollars worth of coal annually, Mr. Patterson said a very simple remedy for inaccurate instruments had been adopted. And this policy had been found to be one of the best dividend producers of all. The plant in question had a full installation of steam-flow meters, stack thermometers, feed-water meters, CO_2 recorders and instruments for indicating feed-water temperature, steam temperature, draft gages and everything else that should enable the boiler-room attendants to maintain plant efficiency. Unfortunately, and of necessity, these instruments did not remain accurate indefinitely, as no instrument can. Stack thermometers became sooted up, dirt and dust, friction and leaks caused inaccuracies to occur, wrong indications resulted and the instruments came into disrepute and disuse.

The superintendent of this plant then had a work shop, consisting of a small room and work bench fitted up, and one or two men assigned to it, according to the demand, to calibrate all instruments and maintain them in proper working condition. This entailed not sporadic work but continuous work since cleaning, calibrating and checking in a station of its size offered steady work for one man all the time and two for a large part of the time.

The result of this workroom and bench, to which has been since added a coal-testing division, has been to place all instruments back on the job and to enable them to function accurately at all times. The aim is to keep instruments in service rather than to repair and re-calibrate them after they are out of service. Coal analysis enables the grade of coal furnished to be checked and too great a variation from the contract grades to be prevented or paid for according to variation. Predetermination of results, uniform results and efficient methods now obtain, followed, of course, by higher evaporation per pound of coal and improved over-all economy generally.

The simple expedient of installing a work shop for the maintenance of boiler-room instruments, and thereby obtaining to the full the return upon the investment, has been found one of the best investments of all.

AIR AND OIL-BREAK SWITCHES FOR OUTDOOR SERVICE.

Review of Situation Shows When Either Piece of Equipment Is Indicated as More Desirable for Installation.

The two major advantages of the air-break switch as compared with the oil-break switch are first cost of the switch itself and the lower installation cost resulting from the facts that the air-break switch occupies less space and may be mounted in the air while the oil-break switch must usually be mounted near the ground. Oil-break switches are more expensive than air-break switches, of course. But the one way in which the low cost of the air-break high-voltage switch can be obtained with but little loss in flexibility existing with the high-voltage oil-break switch, is to install fused air-break switches on the high-voltage side and an oil-break switch on the low-voltage side. The amperage of the fuse on the high-voltage should be such that the low-voltage automatic switch should open in all except the most severe cases of short circuit.

Under short-circuiting conditions, a fuse will open a short circuit much more rapidly than an automatic circuit-breaker. High-tension fuses of good design will clear short circuits in approximately 0.013 sec., which is from ten to twelve times as rapidly as an automatic circuit-breaker. The exceptionally rapid action of fuses will therefore permit over-fusing the transformers theoretically twelve times the normal current and still secure protection equal to that of an automatic oil switch. In actual practice over-fusing from three to ten times normal should be used, depending upon local conditions. For power circuits subject to wide fluctuations, the high-tension circuit opening devices should be so rated that they will not operate except in case of actual trouble, such as transformer failure, and such cases are rare with modern transformer designs.

Such overload protection as is desired can be secured easily and cheaply by means of a low-tension automatic oil switch installed on the secondary side of the transformer bank. In substation practice this combination of heavy high-tension fuses on the primary side which will open only in case of transformer failure and properly adjusted oil circuit breaker on the secondary side of the transformer bank is an excellent protective system often taken advantage of.

The high-tension automatic oil switch has the advantage that it can be used for switching in addition to the overload feature. When fuses are used it is

necessary to install an air-break switch to disconnect the transformers from the line. In actual practice, however, it is often advisable and is considered good engineering practice to install disconnecting switches between the oil switch and the line. The reason for this is that the oil-switch contacts are necessarily concealed in the tanks and to be absolutely sure that a line is clear the disconnecting switches should be opened, thus giving the operator ocular evidence of disconnection.

Should the oil switch open frequently or under severe load conditions, it is advisable to inspect the contacts, oil levels and condition of the mechanism. To enable inspection adjustments or repairs, it is often advisable to install auxiliary disconnecting switches so connected that the oil switches can be shunted and entirely disconnected from the circuit, power being temporarily delivered through the auxiliary switches.

Another point in favor of the oil switch is that after interruption it can, if in good condition, be immediately closed, thus reducing the time of service interruption. It will naturally require more time to open an air-break switch and replace fuses than it will to close the oil switch. The saving of a moment's time may in some instances warrant the additional expense of the oil switch. However, the average high tension substation attendant, especially if not "hardened" by long experience, will after an interruption be inclined to go slow in closing the switch until he can actually view every possible part of the switch mechanism, assuring himself that it is in condition to resume service.

The fuse and air-break switch combination has, therefore, a certain advantage in that every part of the units, including contacts and the condition of fuses are in plain view of the attendant.

The above are excerpts from a paper by H. W. Young entitled "Modern High-Tension Outdoor Substations" presented before the Illinois State Electric Association's convention in Chicago October 23 and 24.

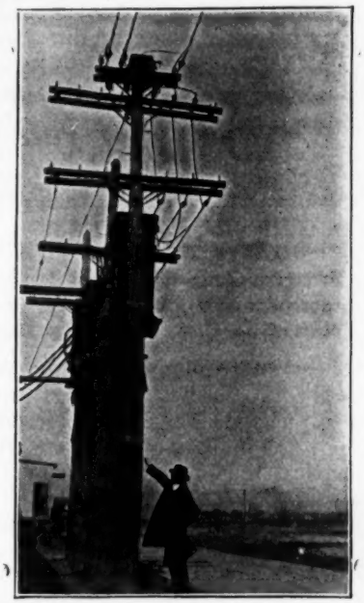
FORM OF OUTDOOR SUBSTATION FOR HEAVY LOADS IN CITY LIMITS.

Salient Features of Structure Used for Some of Cleveland's Heavy Industrial Loads.

Every transformer mounted upon a pole is, in a sense, an outdoor substation. And yet when speaking of outdoor substations something different is implied and understood. When serving heavy loads, as some large industrial plant, within city limits, apparatus must often be mounted upon poles out of ready reach of pedestrians, and yet the nearer the transformers are located to the service connection, the less the voltage drop and line loss on the secondary, likewise, the less work required to hoist the transformers up the pole.

In the accompanying illustrations is shown a type of transformer mounting used by the Cleveland Electric Illuminating Co. for serving some of its heavy loads from overhead lines. These transformer banks are located directly at the load and often on the customer's right-of-way, and vary from 100 up to several hundred kilovolt-amperes in transformer capacity.

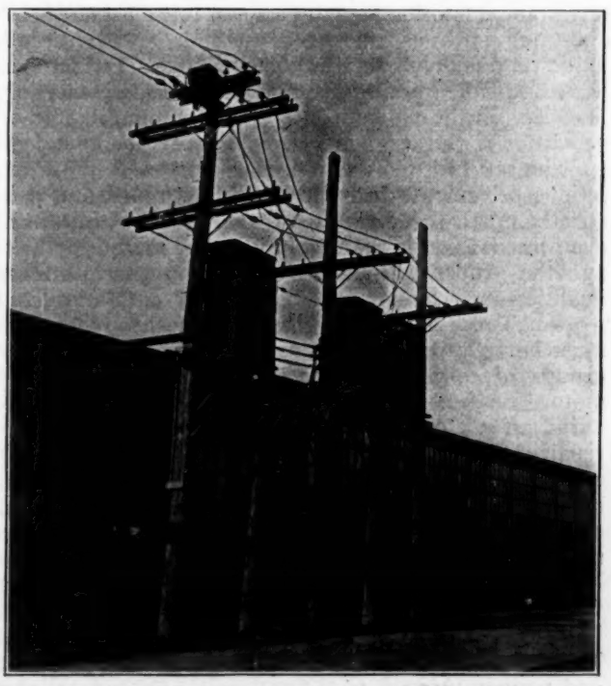
The installation shown consists of three 200-kv-a. single-phase transformers stepping down from 4160 to 460 volts. Space exists upon the transformer platform for a fourth unit. The supporting structure consists of three 35-ft. and two 25-ft. cedar poles. The transformers are mounted 14 ft. from the ground. The secondary leads are of No. 4/0 copper, there being



End View Showing Oil-Switch Control Ropes, Lightning Arresters and Conductor Arrangement.

three leads per phase, an arrangement that not only simplifies handling, but lowers resistance and also inductive drop. It may be noticed that the secondaries are fairly short, a further factor contributing to good voltage regulation.

The transformer bank is controlled by a 4500-volt automatic oil-switch mounted upon the top arm. This switch may be operated from the ground by means of ropes that pass down the side of the pole. Between the oil-switch and the transformer bank are installed compression type lightning arresters, one per phase.



Three 200-kv-a. Transformers Mounted Upon Platform with Automatic Oil Switch and Control Ropes.

Contracting-Construction

St. Louis Contractor Comments on Repair Business—Dallas Jovians Co-operate With Architects—Mine Feeder Wires

POINTS ON CONDUCTING AN ELECTRICAL REPAIR BUSINESS.

Suggestions Brought Out in a Paper Read Before the Missouri State Association of Electrical Contractors and Dealers by C. J. Briner, St. Louis.

Because electrical equipment will deteriorate and wear out, even with the best care and attention, and because abuse, neglect, misuse, defective materials and causes beyond human control must be taken to task, the electrical repair shop has a perfectly legitimate standing in the electrical industry. It may safely be said that 20% of all material such as insulation and copper products is used for replacements.

For one to be successful in the repair business the first requisite is 75% knowledge, gained by experience and study, and 25% in surrounding yourself with capable help and equipment. These figures refer to motor and generator repairs, omitting such repairs as those of household appliances, vacuum cleaners, fan motors, heating devices, telephones, etc.

Knowledge of Electrical Equipment.

Any one engaged in the repairs of electrical apparatus should certainly have knowledge of the various types of motors and generators, both old and modern, their principles and functions, the various types of windings, the temperature guarantees, and, above all, an idea of costs. There are no miracles or guesswork in the repair business; what the engineers in laboratories and factories have laid down must be repeated, excepting such as improved methods and materials only; very seldom can a motor or generator which has been a so-called hot one be made to operate cooler, or, likewise, can heat be put into a cool-running motor or generator if the original principles are adhered to.

The ratio of turns and sizes of wire with the revolutions per minute have been predetermined and it is strictly up to the repair man to reproduce the same; even in changes of the revolutions per minute or voltage the proper ratio must be maintained. Running qualities may be improved by better insulation and workmanship, but the original fundamental principles must be followed. Changing the turns or number or groups of coils affects the speed and horsepower of motors or generators, and changing the sizes of the wires affects carrying capacities. When a motor is repaired properly its test should verify the nameplate unless the latter has been tampered with. With the limited spaces for wires in the slots of armatures or stators or rotors, it is almost impossible to make a mistake unless wantonly so.

Motors and generators built today have the same fundamental principles they had 25 years ago, excepting that they have been mechanically refined and higher values obtained with relation to copper, iron and temperature.

The repair shop does not only attempt to restore to a sound or good state worn and defective apparatus, but should afford prompt and efficient service when catering to the public. Therefore, about the first requirement to consider in a large or a small shop is a good system. When apparatus is received for repairs there should be attached a tag on which full information, such as the owner of the apparatus, date received, maker, horsepower, kilowatts, voltage, amperage, revolutions, type, direct or alternating current, phase, whether with base, pulley, starter or rheostat, etc. This identification tag can be used for any form of apparatus and also for further identification in carrying the repairs through the shop.

Good Shop Systems.

In many instances it becomes necessary to determine the extent of repairs necessary and to confer with the owner as to cost before proceeding with repairs, or an exchange may be affected, all of which means that considerable detail work must be done before final disposition is made.

Motors or generators entered for repair should carry a shop working order and a data card, the latter giving a full description as to repairs, type of winding, number of coils, sizes of wire, etc. A complete time and material record must be kept along with the data for the purpose of rendering a proper bill as well as for comparing costs with the estimated price so the self-preservation of the bank account may be maintained.

It is quite a problem to secure competent help, but having a good simple system will help matters wonderfully. The employe should feel that full knowledge and instructions, especially useful prints and bulletins, can be had and that he can consult superiors without hesitancy or timidity. Most repair men have limited experience. Armature winders can be easily trained because most armatures and stators are coil wound and in many cases hand-wound armatures can be changed to form-wound. Field and coil winding is entirely given over to apprentices. In making repairs outside of the shop it is safest to send good, capable men with instructions to reserve their opinions and communicate with superiors when in doubt. It should be remembered that the customer is usually somewhat excited or exceedingly anxious to resume operations and the repairman must be 100% efficient or the customer will find fault.

Repairs Outside the Shop.

It is a safe policy to have outside workmen get their time as well as the acceptance of job O. K.'d by the customer and so avoid any disputes as well as assuring everyone connected with the transaction that it was performed satisfactorily.

When doing emergency or temporary repairs the client should be advised accordingly, for he may recall a bill of several months' standing when another breakdown occurs and ask for an allowance or refuse

to pay, being under the impression that repairs last forever.

In my long experience I have found it does not pay to attempt any patch work. It will only be a short time until permanent repairs become necessary and, although inconveniencing your customer for the time being, a good job takes a little longer and saves time, aggravation and money in the end.

When complete, apparatus should be given a good free running test and a voltage at least three times normal voltage for ground and short-circuit should be applied. All terminals for armature, shunt or compound fields or phase connections should be plainly marked whether for motors, generators, compensators or starters, and the direction of rotation should be indicated by arrows.

Referring to materials and insulating varnish, the best motto is, "Let quality be uppermost; buy the best." Insulation is the cheapest part of electrical apparatus but the most expensive if not handled properly; therefore, for the small difference in price, quality should not be sacrificed. Copper products cost in direct proportion to the market base price. Anticipate stockroom needs, for nothing is worse than to be without materials, especially for emergency repairs. Ninety per cent of the motor and generator users have not learned to carry spare parts and depend upon stock. They will insure their factories against fire and water damage, but neglect operating insurance by buying extra armatures, etc.

When rendering an invoice it should read as plain as possible, giving the identification numbers and the specified character of repairs. When crating or shipping apparatus is used, it must be properly and securely constructed in order to lessen freight damage claims, secure prompt deliveries, relieve the worry of retracing shipments and avoid missing parts.

DALLAS JOVIAN LEAGUE TO EDUCATE ARCHITECTS AND CONTRACTORS.

The Dallas Jovian League, which includes in its active membership over two hundred of the men in every branch of the electrical business in Dallas, Texas, has recently by amendment of its constitution opened its membership to architects and also to building contractors. This action was taken with the idea, as expressed in its constitution, of "inducing the architects and contractors to provide full modern facilities for the use of all forms of all electrical apparatus and devices and also to induce such to specify and use approved, modern materials, appliances and apparatus and to have these installed in a safe and convenient manner."

In order to give full expression to this matter the league invited to its regular luncheon on Oct. 20, the architects and contractors of the city. The idea of the meeting was opened to them in an address by a member of the league which was replied to by addresses from prominent architects and contractors and committees were formed to carry forward this plan of co-operation into actual practice.

The idea of the league is to make itself, through its secretary and committees, a free bureau of information to the architects and contractors not only with reference to the proper wiring of all buildings but also to advise them as to the best apparatus and appliances to be used in each particular case and the proper and most convenient method of installation. In fact, it is hoped to make of the league a free bureau of advice and assistance to every one directly or indirectly connected with the electrical business in Dallas.

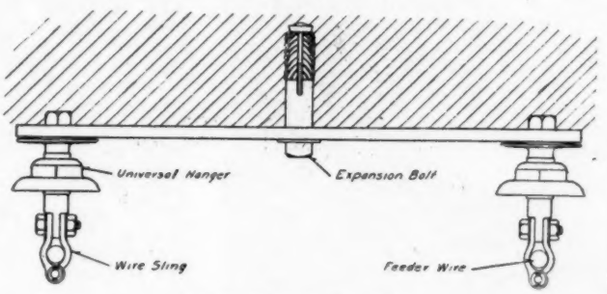
It is further the intention of the Dallas Jovian League, if this idea proves a success in Dallas, to endeavor to extend the idea to other large and medium-sized cities of the state and in this way standardize the electrical business throughout Texas.

This plan does not include any idea of merchandising electrical supplies or apparatus, as it is believed that this latter can best be accomplished through the medium of the National Association of Electrical Contractors and Dealers, the organization of local branches of which is to be undertaken in Texas.

SUPPORTING FEEDER WIRES IN MINES.

A method of supporting machine and feeder cables which is a considerable improvement over the common method of supporting such wires on porcelain spool insulators, has been worked out by John Oniones, Indiana Creek Coal Co., Bicknell, Ind.

The arrangement is shown in the accompanying illustration in which a single expansion bolt supports



Feeder Support for Mines.

both wires. The cross member is a structural steel bar upon each end of which is mounted a universal mine hanger. A cable-sling supports a feeder wire from each of these hangers.

The cable is held more securely by the sling than it could be by a tie wire on the usual type of porcelain spool.

STANDARDIZATION IN CONSTRUCTION.

The National Association of Construction Industries, with offices in the Drexel Building, Philadelphia, has taken up the matter of the need for further standardization in construction activities, and is sending to associations, business firms and individuals a questionnaire asking for the following information:

1. Is there need for further standardization in your branch of construction activity?
2. If there is, what are the needs and what are your suggestions for meeting them?
3. Are you or your association in a position to co-operate in a program of standardization designed to embrace every field of activity concerned?
4. What suggestions have you or your association to make in connection with such a program?

The cost of labor has advanced to a point where the welfare of the construction interests and the general public will be conserved by adopting methods through standardization which will reduce the percentage of labor cost in construction. It is apparent that through the associated effort of all construction interests valuable results can be accomplished which would not be obtained by any single branch of the industry working alone, and it is for this reason that the association has taken up the matter.

New Appliances

Interesting Installation of Dock Cranes at Boston Army Supply Base — Electric Furnace Equipment for Norway

Government Acceptance Test of Dock Cranes at Boston Army Supply Base.

The Wellman-Seaver-Morgan Co., Cleveland, Ohio, recently installed four semi-portal bridge-type hoist cranes at the U. S. Army Supply Base, Boston, to handle freight to and from ships. The Boston terminal includes a long eight-story warehouse separated by a

View of Dock Cranes From Wharf Deck.

wide street from the marginal two-story wharf house alongside the wharf where the ships dock. Between the wharf house and the water is a space 35 ft. wide with two standard-gauge tracks on which freight cars are run in from main-line tracks to deliver or receive freight from the boats. The W-S-M cranes span these tracks, as will be seen in the illustration herewith. These cranes were described in our issue of Sept. 13, 1919.

The Government acceptance test of the cranes was made Sept. 17, at which time all four cranes were operated under full load. The speed of the different motions and cycle of operation exceeded in every instance those called for in the specification. The test load consisted of a steel bucket filled with cement sacks, the total weight being 5,000 lbs.

In unloading wool from barges on the same day, one of the cranes made 73 trips an hour, taking on each trip three bales weighing from 500 to 800 lbs. each. It was required to unload the barges evenly, making it necessary to take a load alternately from each end and the middle and landing the loads all in the same place. This method of handling meant a considerable time spent in bringing or traveling along the dock.

The operation included picking up of the wool from a lighter at the wharf side about on the level of the wharf, making a vertical lift on the hoist line of about 40 ft., rotating the boom through an angle of about 120°, traveling of the bridge about 30 ft. along the wharf, and delivering the load on the upper deck platform along the wharf shed. The crane made the complete cycle in about 45 seconds, which would mean 80 trips per hour, but due to unavoidable delays in the hour the number of trips made was 73. The number of men employed in connection with operating the crane was as follows: 1 superintendent, 1 crane man, 1 foreman on the shed platform, 1 foreman on the lighter, 1 tally man, 3 gangs of 5 men each on the lighter, 3 men to receive the load on the upper bench level and to assist in loading the material on the trucks, 11 truckers, and 4 men storing the material, making a total of 38 men. Naturally the number of truckers and those required for storing the material is determined by the method of storing and the distance the truckers must travel to deliver the material inside the shed.

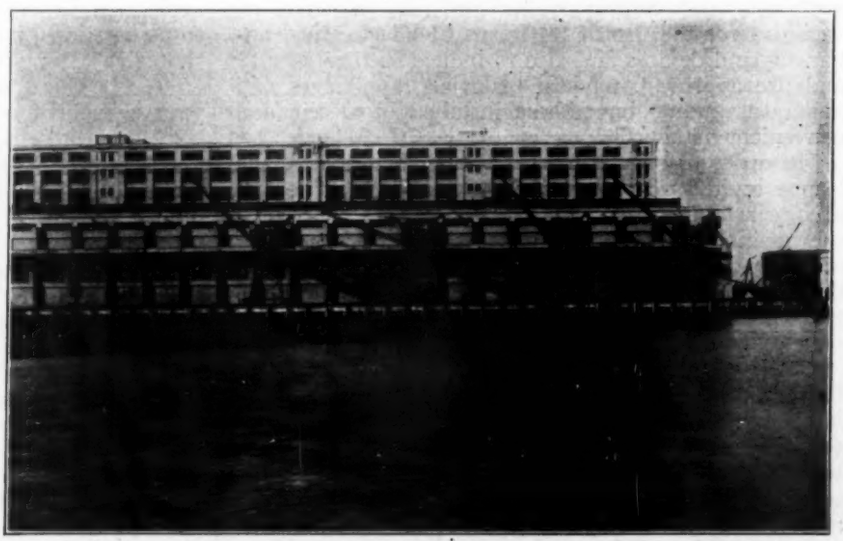
The alinement of the hoisting units and the reduction of friction by the use of Hyatt bearings is well illustrated by the following performance: The weight of 375 lbs., consisting of the lifting hook, 2 ft. of crane chain, the fall weight and 10 ft. of hoisting line, is sufficient to allow the hook to lower at a fair rate of speed and pull the hoisting rope over two sheaves while unwinding the rope from the hoisting drum, rotating the drum, drum gear and drum gear pinion. This takes effect when the jaw clutch is in its neutral position, freeing the drum from the motor and the hold brake on the drum is released.

Notable Export Shipment of Electric Furnace Equipments with Unique Voltage Control.

Electrical equipment for twenty electric furnaces which, when placed in operation, will comprise the largest electric furnace installation ever made, is now being shipped from the United States to the Glomfjord Smeltverk Co. of Glomfjord, Norway.

The apparatus was made by the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa., and is divided into units, each unit comprising the equipment for one furnace. Each of the twenty units includes a 1300-kv-a. single-phase main power transformer, a 26.2-kv-a. series transformer, a 26.2-kv-a. induction regulator, an automatic selector switch, a transformer switch and a two-panel separately mounted switchboard for the control of the electrical apparatus. A total of 16,200 gallons of oil for insulating and cooling the transformers and regulators is part of the shipment.

The general scheme of connection is such that the voltage variation necessary to the heat regulation of the furnace is accomplished by changing taps on the high-voltage winding of the main power transformer. A portion of the winding, which is proportional to the amount of voltage control desired, is provided with taps in a number of equal steps. Switches and induction regulator operate together to automatically change connections on the high-tension winding and to provide voltage control on each step. In this scheme, the capacity of the regulator need be sufficient to control only the voltage of one step on the tap winding, thus maintaining a high power-factor.



View Taken From Roof of Wharf Shed of Four Semi-Portal Bridge-type Dock Cranes

Trade Activities

Block & Company Engage New Quarters—Exhibit of Electric Service Construction—Valuable Literature Distributed

Page & Hill Co., Minneapolis, is building a new yard office and laboratory at its Minnesota transfer plant. It is to be modern in every respect. It will contain in addition to the main work room, private offices for the superintendent and private offices and laboratory for the inspection engineer and chemist. Lavatory and shower baths are provided.

McGill Manufacturing Co., Valparaiso, Ind., is sending out a new folder, illustrating and describing various types of Loxon lamp guards. It is a double-duty device eliminating the needless waste of saving incandescent lamps, preventing loss by theft and reducing fire danger from hot or broken lamps. One of the lamp guards listed is of vaporproof construction and is designed to meet the requirements of the garage or wherever gases or inflammable materials may be used.

Lynton T. Block & Co., operators of the Utilities Indemnity and Fire Exchanges and Employers' Indemnity Corp., announce their removal to permanent quarters, consisting of the entire second floor of the new Chamber of Commerce building, Broadway and Locust street, St. Louis. The business of the Utilities Indemnity and Fire Exchanges and the Employers' Indemnity Corp. has grown so rapidly that the acquisition of these new and spacious quarters has been necessitated. After Nov. 8 all correspondence should be addressed to the Chamber of Commerce building, Broadway and Locust street.

Beardslee Chandelier Manufacturing Co., 216 South Jefferson street, Chicago, is sending out a new folder to department stores all over the United States, showing how effectively the Denzar unit may be used in department store illumination. It is one of the most efficient, durable and economical units for store lighting, properly diffusing and distributing the light rays and eliminating the objectionable glare. A detailed description of the Denzar is given and a cross-sectional view included, showing the various parts of this lighting unit. It is made in many different types and sizes to fit every lighting requirement.

Belden Manufacturing Co., Chicago, has issued its Bulletin 1208, descriptive of "Beldenmold" synthetic molded insulation. It is a 20-page booklet which includes descriptions of the properties of "Beldenmold" and the uses and manufacture of molded pieces. Terms and conditions governing quotations, orders and production of "Beldenmold" parts are given in detail, affording the prospective buyer much information as to the advantages and the pitfalls to be avoided in purchasing molded parts. The booklet is profusely illustrated, showing the large variety of purposes for which molded products can be used.

George Cutter Co., South Bend, Ind., has issued bulletin No. 3386, which is a 48-page catalog of its extended line of streethoods, brackets, mast-arms, pulleys, insulators, and other pole-line and street lighting equipment. In the introductory pages is set forth a review of the modern street lighting system and the applicability of Cutter streethoods and Regent film sockets thereto. Construction of these streethoods is described and illustrated and their distribution curves shown. In the strictly catalog pages are shown several hundred views and detail diagrams of the various types of streethood fixtures, brackets, center suspensions, sockets, mast-arms, pole fixtures, pulleys, crossarms, insulators and pole-line hardware. Three pages of indexes complete this book which will be found valuable by all engineers and contractors of street lighting systems of this type.

Cutler-Hammer Manufacturing Co., Milwaukee, Wis., has issued a new four-page, two-color pamphlet No. 479 entitled "Miscellaneous Applications of Electrical Heat," illustrating and describing C-H space heaters. It emphasizes numerous applications of electrical heat by means of flat standardized heaters, two ft. long, 3/16 ins. thick and 1½ ins. wide. The entire heater is built to withstand hard service and vibration. All parts are enclosed and cannot jar loose. There is no porcelain, cement, asbestos or molded insulation material used, the resistance being encased in sheet mica which in turn is encased in a steel jacket. After sealing, the heater is placed in a hydraulic press and 25 tons pressure applied. Ten of them, constituting a standard package, are packed in a box which affords a handy means of storing and identifying them. C-H space heaters have been used in scores of applications, notable among them being crane and hoist cabs, meter houses, valve houses, sprinkler riser houses, low temperature ovens including the new electrically heated bread ovens and many others. A partial list of the many applications is given in the new pamphlet. Methods of mounting, methods of connecting dimensions, wattage weights, code numbers and prices are also included in the pamphlet. Space is provided for dealers' imprint as a large number of jobbers and supply houses now carry the space heaters in stock. They are a product of the industrial heating department of the Cutler-Hammer Manufacturing Co., Milwaukee.

Electric Service Construction Co., electrical contractor, 322 Sherman street, Chicago, Ill., had an interesting exhibit, especially to wiremen and builders, at the recent Chicago Electrical Show. The repair work done by the company was featured, parts of motors, field coils, commutators, ets., showing samples of the work done by the company. The electrical construction side of the business was played up by over 50 letters displayed in appropriate glass frames. The letters consisted of orders and recommendations received by the company from customers who had expressed their satisfaction with the work done for them by the company. Another part of the exhibit was a display of antique switches, fuse blocks, fuses, lamp sockets and telephone desk sets. Some of these curios were of the vintage of the '80s and attracted much attention. P. C. Moore, president of the company, said numerous inquiries were received at the show for construction and repair work. In connection with the exhibit the Electric Service Engineering Co., an affiliated company, which is the distributor for the Pierce Fuse Corp. in the Chicago district, made an exhibit of Pierce fuses. According to R. S. Blake of the company, several hundred live prospects for Pierce fuses were obtained at the show.

I. P. Morris Co., owned and operated by the William Cramp & Sons Ship & Engine Building Co., has distributed Bulletin No. 4, of the hydraulic department, on hydraulic turbines. The catalog, which is illustrated, contains 90 pages of pictures of important installations and of printed matter. The printed matter consists of a technical discussion of the water power situation in the United States, and the part that the I. P. Morris Co. has taken in the development of hydraulic energy since the organization of the Morris Iron Works in 1828. During the 30 years preceding 1911, the company supplied turbines for the development of 855,835 hp., whereas, in the interval, 1911-1914, it supplied turbines to develop 827,885 hp. The matter in the catalog includes a discussion of factors affecting the success of a hydroelectric plant, a short history of the evolution of the hydraulic turbines, and a discussion of speed regulations. The photographs include views of entire plants in which Morris turbines have been installed, views of the interior of power houses, and of turbines and parts erected in the shops. The views show the details of the operating parts, the methods and apparatus employed to regulate the gates, and the floating lever type of hydraulic governor. Copies of this bulletin may be obtained upon request.

Current News

Weekly Record of Construction Activities—Conventions

EASTERN STATES

Cambridge, Mass.—Cambridge Electric Light Co. has completed arrangements for the construction of the proposed one-story addition to its local substation to provide for increased operations. Walsh Brothers, Cambridge, are the contractors.

Holyoke, Mass.—Walsh Steam Boiler Works, Appleton street, has completed arrangements for the erection of a two-story brick and concrete addition to its plant, about 81x140 feet.

Lynn, Mass.—Contract has been awarded by the city council to Bertram & Fox, 45 State street, for the construction of a new municipal engine plant on Chestnut street.

New Bedford, Mass.—National Spun Silk Co. has broken ground for the construction of the proposed power plant at its works to be located at Bullard street. The structure will be one-story, brick and concrete, about 84x123 ft., and is estimated to cost $175,000, including equipment installation.

Springfield, Mass.—In connection with the construction of the proposed additions to the plant of the Fisk Rubber Co., Chicopee, Mass., contract for which was recently awarded to the Fred T. Ley Co., Springfield, plans have been arranged for the erection of a new one-story and basement brick power plant, about 23x40 ft., to be used for general factory operation.

Warren, Mass.—Warren Steam Pump Co. has recently broken ground for the construction of a new one-story boiler plant at its works, about 40x60 ft., in connection with the erection of other additions to the plant to provide for increased capacity.

Middletown, Conn.—Russell Manufacturing Co. has awarded a contract to Dennis O'Brien & Sons, Crescent street, for alterations and improvements in its factory and power plant. The work is estimated to cost $50,000.

Norwalk, Conn.—Fire recently damaged the plant of the Hi-Po Battery Co., manufacturer of electric batteries, etc., to the extent of approximately $10,000. It is understood that the company is planning to rebuild at once.

Norwalk, Conn.—In connection with the construction of the proposed four-story plant of H. Jacob & Sons, about 50x200 ft., to be devoted to the manufacture of shoes, plans are being arranged for the erection of a new brick and concrete power plant to be used for general works operation. J. C. Schaeffler & Co., 38 West 32nd street, New York, are architects.

Pawtucket, R. I.—Collyer Insulated Wire Co., 249 North Main street, has awarded a contract to the Fred T. Ley Co., Springfield, Mass., for the construction of a new two-story concrete addition to its plant to provide for increased output. The structure will be located on Blackstone avenue, about 60x120 ft., and is estimated to cost $100,000.

Westerly, R. I.—New England Silk Co. will erect a new power plant, 30x40 ft., in connection with an addition to its works to cost about $150,000.

Bath, N. Y.—Town council, municipal lighting and power system, James Foster, chairman, is having plans prepared for the construction of a one-story addition to the municipal power plant to provide for increased operations. The structure will be about 42x65 ft. and is estimated to cost $25,000.

Binghamton, N. Y.—In connection with the proposed construction of the plant of the Vulcan Last Co., Portsmouth, Ohio, on property recently acquired at Johnson City, arrangements have been made whereby the Binghamton Light, Heat & Power Co. will furnish electric energy for operation. It is proposed to commence construction at once to enable the company to inaugurate operations early in 1920. The new works will cost about $200,000.

Brooklyn, N. Y.—Riggi Brothers, 1216 Lexington avenue, have had plans prepared for the construction of a new one-story reinforced concrete boiler plant addition to their works to provide increased operations. The structure will be about 25x60 ft. P. Tillion & Sons, 103 Park avenue, New York, are architects.

Brooklyn, N. Y.—Brooklyn Edison Co., Pearl and Willoughby streets, has awarded a contract to the Maxis Engineering & Construction Co., 26 Court street, for the erection of a new one-story extension at its local plant.

Buffalo, N. Y.—Wright-Hibbard Industrial Electric Truck Co., manufacturer of electrically operated trucks, etc., has filed notice with the Secretary of State of an increase in its capitalization from $300,000 to $550,000, to provide for proposed business expansion.

Cato, N. Y.—Northern Cayuga Light & Power Corp. has made application to the Public Service Commission at Albany for permission to begin construction and exercise rights and privileges under its franchise and for authority to issue $25,000 in capital stock.

Glens Falls, N. Y.—Adirondack Electric Power Corp. is having plans prepared for the construction of a one-story extension to its plant on Monican street. The structure will be of brick, concrete and steel, about 21x104 ft.

New York, N. Y.—United Electric Light & Power Co., 130 East 15th street, has been awarded the contract for furnishing electric service in connection with the operation of the new Capitol Theater, 1645 Broadway.

New York, N. Y.—Standard Electric & Repair Co., 50 University place, has completed negotiations for the leasing of property at 64 University place, for a new establishment.

New York, N. Y.—Gryphon Rubber & Tire Corp., Bailey avenue and 192nd street, has had plans prepared for the construction of a new one-story brick boiler plant at its works The structure will be about 40x42 ft., and is estimated to cost $10,000. Frank Sutton, 80 Broadway, is architect for the company.

Rochester, N. Y.—Considerable new electrical equipment will be required by the Rochester Motors Co., Inc., in connection with the proposed construction of a new one-story machine shop addition to its plant, about 100x390 ft.

Harrison, N. J.—Driver-Harris Co., manufacturer of electrical wires, cables, etc., has broken ground for the construction of two additional units at its plant, to provide for increased operations. The structure will comprise a three-story building, about 50x100 ft., brick and concrete, to be used as an addition to the wire department, estimated to cost approximately $60,000; and the other structure will be about 26x60 ft., costing about $5000, and will be utilized as an extension to the hammer department. Edward M. Waldron, Inc., 665 Broad street, Newark, is the building contractor.

Jersey City, N. J.—Leeds Phonograph Record Co., Record and Review streets, Long Island City, N. Y., has awarded a contract to Walter Kidde & Co., 140 Cedar street, New York, for the construction of a new one-story boiler plant, between Harrison and Warren streets, Jersey City, about 28x49 ft.

Keyport, N. J.—Monmouth Lighting Co. has been awarded a contract by the Borough Council for furnishing electric service for the operation of the municipal street lighting system for a period of one year.

Lakewood, N. J.—Gas & Water Co. has awarded a contract to the Pennsylvania Engineering Co., 1119 North Howard street, Philadelphia, Pa., for the construction of a new station at its plant. The structure is estimated to cost $20,000.

Newark, N. J.—Plans have been completed for the immediate construction of the proposed radio sta-

tion at Heller Field, the main eastern air mail station of the Post Office Department.

Newark, N. J.—Clifton Electric Co. has filed notice of organization to operate in a general electrical contracting capacity at 107 Belmont avenue. Herman and Albert Friedenreich, 156 Spruce street, head the company.

Newark, N. J.—Rubber & Celluloid Products Co., 56 Ferry street, is having plans prepared for the construction of a one-story brick boiler plant at its works, to provide for general factory operation. The structure will be about 20x52 ft. Clark, MacMullen & Riley, 101 Park avenue, New York, are engineers for the company.

Pompton Lakes, N. J.—Tri-County Electric Co. has completed the construction of its power lines in Wanaque Borough as far as the Haskell School site, as well as in a large part of the Riverdale section of Pequannock township.

Easton, Pa.—Pennsylvania Utilities Co. is making rapid progress on the installation of three new boiler units at its Dock street plant. Two of these units will be of 600-hp. rating, and the other of 1000-hp. capacity, and it is expected that the work will be completed during November. Effective Oct. 1, the company has resumed its steam heating service following the yearly summer suspension, during which period alterations and improvements were made in the system to facilitate operations.

Nanticoke, Pa.—Duplan Silk Co., 50 Union Square, New York, has awarded a contract to the United Fireproofing Co., 8 West 40th street, New York, for the construction of the proposed two-story boiler plant at its local works. The structure will be about 90x100 ft.

Nanticoke, Pa.—Delaware, Lackawanna & Western Railroad Co., Scranton, has broken ground for the construction of a one-story boiler plant, about 48x154 ft. at its Truesdale Colliery, near Nanticoke. The structure, with equipment, is estimated to cost $75,000.

Philadelphia, Pa.—Stroudsburg Electric Light & Power Co. and the Industrial Power Co. have reorganized as the Lehigh Industrial Power Co. First mortgages held against the property of the Industrial Power Co. and effective likewise against any extension made in the name of the reorganization of the company's subsidiary concerns into a new corporation which could issue bonds on new improvements.

Philadelphia, Pa.—American Manganese Bronze Co., Rhawn and Hegerman streets, has completed arrangements for the installation of new boiler equipment at its plant, to facilitate operations.

Philadelphia, Pa. — The United States Government has taken bids for the construction of the proposed power plant at the Frankford Arsenal.

Philadelphia, Pa.—American Preserve Co., 946 Beach street, has awarded a contract to Cramp & Company, Philadelphia, for the erection of a new four-story and basement concrete plant, about 80x250 ft., to be supplemented by a power plant for works operation, at Third and Lehigh avenues. The project, including machinery and installation, is estimated to cost $400,000.

DATES AHEAD.

Electrical Supply Jobbers' Association. Semi-annual meeting, Cleveland, Ohio, Nov. 18-20. Headquarters, Hotel Cleveland. Secretary, Franklin Overbaugh, 400 South Clinton street, Chicago.

American Society of Mechanical Engineers. Annual meeting, New York City, Dec. 2-5. Secretary, Calvin W. Rice, 29 West 39th street, New York City.

American Institute of Chemical Engineers. Annual meeting, Savannah, Ga., Dec. 3-6. Secretary, J. C. Olsen, Brooklyn, N. Y.

Electric Power Club. Meeting, Hot Springs, Va., Dec. 11, 12 and 13. Headquarters, Homestead Hotel. Secretary, C. H. Roth, 1410 West Adams street, Chicago.

National Council of Lighting Fixture Manufacturers. Annual convention, Detroit, Mich., February, 1920. Secretary-treasurer, Charles H. Hofrichter, Cleveland, Ohio.

American Electrochemical Society. Annual convention, Boston, Mass., April 7-10, 1920. Friday, April 9, joint session with American Institute of Electrical Engineers on "Electrically Produced Alloys." Secretary, Joseph W. Richards, Bethlehem, Pa.

National Electric Light Association. Annual convention, Pasadena, Cal., May 18-21, 1920. Headquarters, Hotel Huntington. Acting secretary, S. A. Sewall, 29 West 39th street, New York City.

Philadelphia, Pa.—Continental Mills, Lena and Armat streets, have completed arrangements for the installation of new boiler equipment at their plant.

Pittsburgh, Pa.—Consolidated Ice Co. has filed plans for the construction of a new one-story brick and steel engine plant on 42nd street, near the Allegheny Valley Railroad. The structure is estimated to cost $15,800.

Pittsburgh, Pa.—Duquesne Light Co., Chamber of Commerce building, is making rapid progress on the construction of its new two-story brick substation, about 50x66 ft., to be located in the Fair Oaks section of Ambridge, Pa. The structure will be supplemented by a wing 17x30 ft., and is estimated to cost $50,000. The Walker & Curley Co., Farmers Bank building, Pittsburgh, is the building contractor.

Reading, Pa.—Philadelphia & Reading Railway Co. has recently inaugurated the new system, work on the installation of which has been completed, for the operation of its trains on the Reading-Harrisburg division by telephone. The lines will be used exclusively for the dispatching of trains.

Baltimore, Md.—Universal Centrifugal Dryer Co. has awarded a contract for the construction of a new two-story brick plant, about 40x131 ft., to be located at Carroll and Weaver streets. The structure is estimated to cost $15,000.

Baltimore, Md.—American Can Co. is planning for the installation of new boiler equipment at its property at Boston and Hudson streets.

Cumberland, Md.—Western Union Telegraph Co. and the Baltimore & Ohio Railroad Co. has inaugurated work on the cabling of the new conduit system, recently installed at a cost of about $50,000, extending from the Queen City building to the Viaduct tower. The conduit will carry telephone, telegraph and electric signal wires, and was completed early in August.

Glen Lynn, Va.—Appalachian Power Co., Bluefield, W. Va., is arranging plans for the immediate construction of a new addition, about 60x75 ft., to its local steam-operated electric generating station. Complete equipment will be installed, including a 20,000-kw. G. E. turbine and other operating apparatus, and contract has been awarded to Viele, Blackwell & Buck, engineers, 49 Wall street, New York, for the proposed work. The project will cost in excess of $600,000.

Cameron, W. Va.—Spang & Co., manufacturers of oil well machinery, equipment, etc., have had plans prepared for the construction of a large new power plant to be used for the operation of the proposed local works of the company, to include machine shop, forge shop and auxiliary structures. The new plant is estimated to cost $150,000. V. Monroe, Butler, Pa., is general manager.

Charleston, W. Va.—Chesapeake & Potomac Telephone Co. has recently filed application with the Public Service Commission for permission to increase its rates for service by approximately 30%.

Pemberton, W. Va.—Three pumping units in the mine of the Pemberton Fuel Co. were destroyed by fire on Oct. 27, caused by an explosion. It is understood that the company is planning for the immediate replacement.

Plains, Ga.—City is understood to be considering plans for the installation of a new municipal lighting plant. Bonds to cover the cost of the proposed improvement will be issued. H. R. McGee is mayor.

Miami, Fla.—City has approved a bond issue for $15,000 to cover the cost of the installation of the proposed police signal system.

Winter Garden, Fla.—City has arranged plans for the installation of a new municipal electric plant, to be used for furnishing electric energy for lighting purposes, as well as the operation of the municipal water works system. It is proposed to install complete equipment, including triple and rotary pumping units, internal combustion engines, generators, and auxiliary apparatus. The work is estimated to cost $70,000. Wilbur A. Ginn, Sanford, Fla., is engineer.

NORTH CENTRAL STATES

Indianapolis, Ind.—Link-Belt Co. will build a one-story addition to its foundry. The new addition will be one-story brick and steel, 70x460 ft., to cost $65,000.

Indianapolis, Ind.—Gale Construc-

tion Co. has taken the contract for the installation of a new power plant at the Marion County Tuberculosis Hospital at Oakwood, an Indianapolis suburb. The company's bid was $27,-103.

Belvidere, Ill.—The council has under consideration placing of boulevard lights on Logan avenue. Address Alderman Robinson of the electric light commission.

Berwyn, Ill.—Architects Holabird & Roche, 104 South Michigan avenue, Chicago, have prepared plans for a $20,000 building to be erected by the Chicago Telephone Co., 208 West Washington street. Building to be of brick construction. Specifications include hot water, plumbing and electric lighting.

Chicago, Ill.—John R. Bowes will erect three-story factory building, 268x125 ft., to cost $330,000.

Chicago, Ill.—Charles R. Francis, commissioner of public works, has approved the plans to install complete electrical equipment of the Chicago avenue pumping station.

Dixon, Ill.—Grand Detour Plow Co. works of the J. I. Case Threshing Machine Co. will enlarge its power house. The latest electrical machinery will be installed and the plant will be of sufficient size to provide complete power for the enlarged capacity which the Case company has in view for the Dixon works.

Peoria, Ill.—E. L. Hulsebus, Jefferson boulevard, has prepared plans for a $20,000 building to be erected by the Clinton Telephone & Telegraph Co., Clinton, Ill. Building to be of brick construction. Specifications include passenger elevator, hot water heating, plumbing and electric lighting.

St. Charles, Ill.—Twenty thousand dollars in bonds has been voted to improve the municipal lighting plant. Address the village clerk.

Woodstock, Ill.—Woodstock Typewriter Co. will build an addition to its plant which will increase its production from 55 to 100 machines daily. Address J. P. Swahlstedt, Woodstock, Ill.

Hancock, Mich.—The committee is in favor of installing a meter 700 ft. from the pump and operating the pumping station by electricity. Address the city clerk.

Henderson, Mich.—Henderson Light & Power Co. has organized with a capital of $3000. It will build a plant 30x50 ft. in dimensions and furnish light and power for residences and stores in the town. Harry Coy, president.

Ypsilanti, Mich.—A commitee has been appointed to investigate the cost of boulevard lights on East Michigan avenue. Address the city clerk.

Amery, Wis.—A new electric company has been formed, co-operating with Apple River Milling Co. Lines will be constructed within a radius of four miles. Jake Smith, president; S. Philip, secretary.

Bruce, Wis.—Election will be held Nov. 15 to vote $9000 bond issue for line franchise electric power proposition. Estimate of construction from Ladysmith to Bruce, $12,000. Current will be purchased from Big Falls Power Co., 24-hour service, 3-phase lines.

Darlington, Wis. — City contemplates installing a municipal electric system. Daniel McConnell, city clerk.

Milwaukee, Wis.—Mueller & Sons Box Co., 361 Canal street, will install a generator and electrical equipment. Cahill & Douglas, engineers.

Grand Rapids, Minn.—Prairie River Power Co. will hold public hearing concerning $300,000 electric power plant on Prairie river. Dam will be concrete and stone, two-turbine electric plant of 100 hp. capacity.

St. Paul, Minn.—Lindeke Roller Mills will use 150 hp. of electric energy supplied by the Northern States Power Co., beginning Nov. 1. The West Publishing Co. has installed 44 electrically heated pots in their printing plant. A new $100,000 foundry will be built in the Midway district.

Sioux City, Iowa.—City council will install 3-phase light system to replace 1-phase system; also extend lines to Winnebago, Homer, Walthill, and other towns nearby. J. S. Phillips, mayor; Paul J. Wells, clerk.

Superior, Iowa.—Election carried for electric lighting system, service to be furnished by Northern Iowa Gas & Electric Co., Spirit Lake. E. L. Briggs, clerk.

Joplin, Mo.—In connection with the construction of the proposed local plant of the Junge Baking Co., contract for which was recently awarded, plans have been prepared for the erection of a one-story power plant, about 20x32 ft., to be used for general works operation. The C. A. Dieter Construction Co., Joplin, is the building contractor.

Hugoton, Kans.—An election to vote $70,000 in bonds for waterworks and electric lights will be held Nov. 10.

Hutchinson, Kans.—Contract has been signed by J. H. Springfield, manager of the United Water, Gas & Electric Co., by which this company will furnish electric power for the transmission system of the Pawnee Power & Water Co. of Larned. The contract calls for the furnishing of at least 1500 kw., with the agreement that it furnish as much as 3000 kw. if necessary.

Diller, Neb.—A franchise has been granted to J. H. Krug of Marysville for the construction of an electric line into Diller.

Greenwood, Neb.—Election to vote $15,000 for the construction of a transmission line to furnish Greenwood with current carried.

Wood, S. D.—Wood Electric Light & Power Co. will install a system for light and power here.

Cooperstown, N. D.—City will enlarge its electric plant to furnish light and power in Griggs county and all parts of Nelson and Steele counties.

SOUTH CENTRAL STATES

Lexington, Ky.—Fire originating in the pumping plant of the Stoll Oil Co. recently destroyed the works with loss estimated at $40,000. The company is understood to be considering plans for rebuilding.

Starkville, Miss.—The sum of $55,-000 in bonds has been voted to improve the light and water plant. Address the mayor.

Ashdown, Ark. — Commonwealth Public Service Co. is making extensive improvements in the electric light plant here. The company is putting in new and larger poles, and in the near future will install a 110-hp. oil engine.

Oklahoma City, Okla.—Oklahoma Gas & Electric Co. will expend $3,-000,000 for an electric generating station on Arkansas river.

El Paso, Texas.—El Paso Electric Railway Co. has had plans prepared for the erection of new additions to its power plant for increased capacity. It is proposed to furnish electric energy to the city for the operation of the municipal sewage plant. The extensions are estimated to cost $35,000. The work will include the installation of new motors, the construction of a transformer station and power line. J. L. Alexander is superintendent.

Madsonville, Texas.—The capacity of the Madsonville Light & Power Co. has recently been doubled by the purchase of additional machinery costing $8000 and plants are under way to supply current to some of the smaller towns in the section.

Marshall, Texas.—A white way to cost $14,000 is soon to be installed.

WESTERN STATES

Craig, Colo.—C. A. Van Dorn, president of the First National Bank; C. H. Wise and R. S. Hamilton have filed application for a certificate of public necessity and convenience for the establishment of a power and light plant at Craig.

New Raymer, Colo.—Fire recently destroyed the electric light plant here, involving a loss of about $2,000. The electric light plant is operated by a kerosene engine. It will be rebuilt, and it is probable that the town will take over the operation. George L. McQuewn, owner.

Powell, Wyo. — Harry Chapple, Greybull, and E. P. Bacon of Natrona Power Co. of Casper contemplate an electric light and power plant here.

Petersburg, Alaska.—The council has been authorized to issue $75,000 light and power bonds. Address the town clerk.

Centralia, Wash.—Washington-Idaho Light & Power Co., which was recently voted a franchise in Chehalis, is considering the erection of a power plant in Centralia. The plant will furnish power to the Eastern mill, using the mill's slab wood as fuel. The erection of the plant is dependent on the securing of a contract to furnish power to the city.

Spokane, Wash.—Crowley Brothers

will build a sash and door factory to be operated by electricity.

Klamath Falls, Ore.—Pelican Bay Lumber Co.'s plant, recently destroyed by fire, will be rebuilt and operated by electricity.

San Francisco, Calif.—Approval of plans for a hydroelectric generating plant on the north fork of Kern river, which, with transmission lines, will cost $9,231,350, was sought from the State Railroad Commission by the Southern California Edison Co.

FOREIGN TRADE

[Addresses of firms referred to in these trade opportunities may be obtained by writing to the Bureau of Foreign and Domestic Commerce, Washington, D. C., or its branch and local co-operative offices. Request for each opportunity should be on a separate sheet and the file number given.]

Electrical Goods, Engines, Etc. (31,083).—Electricians in Australia desire to secure agencies for the sale of accumulators, power engines from ¾ hp. to 3 hp. and generators and motors up to 4 hp.; also any electrical goods. Reference.

Pumping Plants (31,094).—A member of a traders' association in Egypt desires to purchase and represent in that country manufacturers of tractors, motor plows, reapers, binders, threshing machines, drills, cultivators, pumping plants, all sizes, etc. References.

Pumps, Turbine, Etc. (31,129).—A commercial agency firm in France desires to secure the representation of manufacturers for the sale of machine tools, any machinery necessary to industry, oil motors, compressors, pumps, turbines, material for mines, forge material, lathes with horizontal plates, drilling machines (radial type), and planing machines. References.

Electrical Supplies (31,133).—A firm in Italy desires to secure an agency for the sale of telephonic and telegraphic apparatus and electrical supplies. A full list and description of what is required may be had on application to the bureau and its district offices. Correspondence may be in English. References.

Electrical Materials (31,146).—An electrical goods merchant in Spain desires to purchase and secure an agency for the sale of raw insulated materials for electrical construction and repair shops, high-tension apparatus, telephones, porcelain insulators, copper wires, and copper in bars and sheets. Quotations should be given c. i. f. Spanish port. Payment, cash against documents. Correspondence may be in English. References.

Electrical Supplies (31,166).—A company in England desires to purchase electrical fittings and appliances, steel- enameled conduits for electrical wires, and teak blocks for mounting switches. Quotations should be given c. i. f. English port. Reference.

PROPOSALS

Electric Light Plant.—The town council of Homestead, Fla., will receive bids until Nov. 17 for the installation of a new electric light plant to be used for municipal service. J. Burton is president; I. R. Matthews, clerk.

Electric Light Plant.—Bids will be received Nov. 19 for labor and apparatus to install a municipal electric light plant at Maquoketa, Iowa. The specifications include 250-b.hp. oil engine, generator, exciter, belt and switchboard, transformers, meters, etc. Address D. T. Bauman, city clerk.

NEW PUBLICATIONS

Price of Ferroalloys, Nonferrous and Rare Metals is the title of a publication by H. R. Aldrich and Jacob Schmuckler, issued by the War Industries Board. This bulletin, presenting a study of the wholesale prices of metals other than iron and steel in the period 1913-1918, inclusive, is one of a series of 50 class bulletins dealing with prices during the war. In classifying the list of commodities whose prices were to be studied, these metals were grouped together and three subdivisions made on familiar bases, namely, ferroalloys, nonferrous metals, and rare metals, and are collected in convenient form in this bulletin. Aside from presenting a record of price fluctuations for certain metals and their fabricated products, the bulletin gives briefly the causes of these fluctuations and discusses in some detail the industrial significance of each metal, its production, imports, and exports, and other data.

INCORPORATIONS

New York, N. Y.—Universal Superheater Corp. Capital, $100,000. To manufacture superheaters. Incorporators: J. S. Milne, R. McGregor and J. T. Crane, 2 Rector street.

New York, N. Y.—W. E. Nichols Corp. Capital, $50,000. To engage in a general electrical engineering cacapacity. Incorporators: O. A. Schramm, R. S. King and K. M. Nichols, 882 Eighth avenue.

New York, N. Y.—Traders' Electrical Supply Co. Active capital, $500,000. To manufacture and deal in electrical goods. Incorporators: G. W. Dunn and W. A. and J. Daly, 261 Broadway.

New York, N. Y.—Tiphany Motor Co. Capital, $400,000. To manufacture motors, etc. Incorporators: W. C. Dodge, F. U. Horowitz and L. M. Crumbacher, 1451 Broadway.

New York, N. Y.—Acorn Electric Contracting Co. Capital, $10,000. To engage in a general electrical contracting capacity. Incorporators: S. Wolf, M. Levin and I. Broff, 1155 Longfellow avenue.

New York, N. Y.—Roeser Studios. Capital, $10,000. To manufacture lighting fixtures, etc. Incorporators: R. Y. Barrows, C. V. G. and C. Roeser, 58 West 37th street.

Charleston, W. Va.—Kallmenten-Warner Electric Co. Capital, $10,000. To manufacture electrical goods. Incorporators: I. W. Belcher, O. W. Kallmenten, J. E. Hanley, D. C. and G. E. Warner, Charleston.

Wilmington, Del.—Little Giant Washing Machine Co. Capital, $2,500,000. To manufacture electric operated washing machines, etc. Incorporators: M. C. Kelly, M. L. Horty and S. L. Mackey, Wilmington.

Wilmington, Del.—Ivers-Lee Co. Capital, $2,500,000. To engage in a general electrical and mechanical engineering capacity. Incorporators: P. B. Drew, T. L. Croteau and H. E. Knox.

Tildenville, Fla.—Tildenville Power Co. Capital, $10,000. To operate a local electric light and power plant. C. H. Tilden is president.

Raleigh, N. C.—Carolina Electric Equipment Appliance Co. Capital, $25,000. To manufacture electrical appliances. T. A. Norris is the principal incorporator.

Miami, Fla.—Monad Electric Co. Capital, $10,000. To manufacture electrical supplies. W. B. Scott is president.

Indianapolis, Ind.—R. C. Dunn Manufacturing Co. has been incorporated with capital of $40,000 by R. C. Dunn, J. I. Dunn and S. W. Dunn.

Peoria, Ill.—Continental Electric Sign Co. has been incorporated with capital of $25,000, by W. G. Ronny. R. H. Morey and J. B. Wolfenbarger of Peoria, Ill., and H. H. Marriott, of Kansas City, Mo. The company will manufacture and sell electrical advertisement signs and displays.

Vincennes, Ind.—Indiana Power Co. has been incorporated with capital of $5,000,000 to supply light, heat and power for the city of Vincennes. Address C. E. Gregg, Vincennes, Ind.

Kindred, N. D.—Kindred Light & Power Co. has incorporated with a capital of $15,000. Address John Ottis.

Milbank, S. D.—Milbank Power Co. has incorporated with a capital of $50,000. Arthur M. Savage, Everett P. Winter, Philip G. Saunders.

Boston, Mass.—Massachusetts Electric Dredge Co. has been incorporated with capital of $50,000. Incorporators: Charles E. Fay, Fred C. Fernald and Forrest H. Abbott. Quincy, Mass.

Louisville, Ky.—Peerless Storage Battery Co. Capital, $50,000. Incorporated under Delaware laws. To manufacture storage batteries. Incorporators: D. Warren, A. E. Wolke, and F. A. Kronuer, all of Louisville.

Personal

H. F. Thurber Elected President of New York Telephone—O. T. McLean Resigns from Northwest Utilities—Changes

LEONARD H. KINNARD, Philadelphia, Pa., was elected president of the Bell Telephone Co. of Pennsylvania at a special meeting of the board of directors. Mr. Kinnard succeeds Frank H. Bethell, of New York, recently resigned.

L. L. HILL, Page & Hill Co., Minneapolis and J. D. Burns, inspection engineer for the company, attended a meeting of the committee on "non-pressure treatment for wood preservation" at the Forest Products Laboratory, Madison, Wis., last week. Mr. Hill is chairman of this committee.

MURRAY C. BEEBE, professor of electrical engineering, University of Wisconsin, has accepted a position in the research department of the Western Electric Co., New York City. He will have charge of investigating the financial possibilities of inventions and labor-saving devices that are submitted to the company.

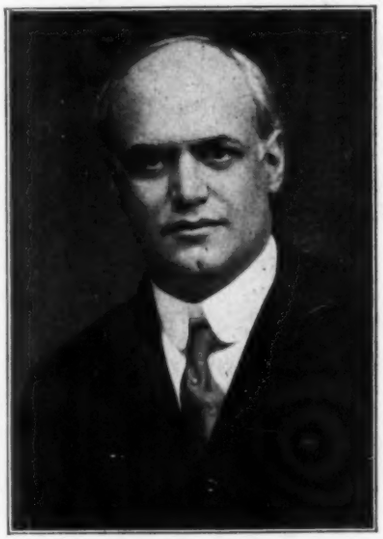
WALTER MCCRUM, assistant manager of the Clark Electric Manufacturing Co., Middletown, Conn., has resigned to accept a position with the Haytian American Corp., which controls the electrical output of the island of Hayti, West Indies. Mr. McCrum has left the country to take up his new duties.

H. E. TOWLE, vice-president and secretary of the American Water Works & Electric Co., 50 Broad street, New York, has resigned, effective Nov. 1, to become a member of the banking firm of W. G. Souders & Co. C. S. ASHDOWN, treasurer of the company has been elected vice-president to succeed Mr. Towle, and W. K. DUNBAR has been appointed secretary.

DR. LEONARD F. FULLER, who recently became assistant manager of the insulator factory of the Ohio Brass Co. at Barberton, Ohio, has been honored with the degree of Ph.D. in electrical engineering by Stanford University in recognition of his work in wireless. Dr. Fuller is said to be the greatest single contributor to the development of long-distance transmission in radiotelegraphy, and his work with the Federal Telegraph Co., Palo Alto, Cal., with which he was formerly connected, has won for him the highest academic honors as well as nation-wide recognition.

SAMUEL B. TUELL, formerly with the Stone & Webster Engineering Corp., Boston, Mass., is now manager of the Houghton County Electric Light Co., Houghton, Mich. He is a graduate of the electrical engineering course of the Massachusetts Institute of Technology and has gained an extensive experience in engineering work in his connection with the Stone & Webster organization, having been employed at Key West, Porto Rico and other places. He was for some time at Pawtucket, R. I., and was later placed in charge of the utility work at Hog Island, later entering the office of the vice-president.

H. F. THURBER, vice-president of the New York Telephone Co., was elected president of the company at a meeting of the board of directors held on Oct. 29. The new president has been vice-president in charge of the companies constituting the eastern group of Bell System Telephone companies, which includes the New York Telephone Co., the Bell Telephone Co. of Pennsylvania, and the Chesapeake & Potomac Telephone Co. Mr. Thurber is one of the best known men in the telephone business. He entered it in 1890 immediately following his graduation from Cornell University as a mechanical engineer. The telephone business was then very young and Mr. Thurber's interest in it was aroused by an address given at Cornell University by Dr. Alexander Graham Bell, inventor of the telephone. His first position was with the Metropolitan Telephone & Telegraph Co. of New York, the predecessor of the New York Telephone Co., and he has risen through the ranks to the position he now holds.



H. F. Thurber.

GUY E. TRIPP, chairman of the board of directors of the Westinghouse Electric & Manufacturing Co., East Pittsburgh, has been elected a director of the American International Corp., succeeding J. Ogden Armour. Mr. Tripp was one of the original directors of the American International Corp., but resigned upon entering the Ordnance Department of the army. He has been chairman of the board of directors of the Westinghouse company for more than seven years.

M. L. MURRAY has resigned his position as branch office manager of the Waterbury Co., 15 Murray street, New York, and has been elected vice-president and general sales manager of the Alloy Metal Wire Co., 146 West 99th street, New York City.

O. T. MCLEAN, who has been connected with the Northwest Utilities Co., has resigned to devote his entire attention to the Electric Service Co., Mankato, Minn., of which he is secretary and treasurer. Mr. McLean entered the employ of the Minneapolis General Electric Co. in 1910, and when the company was sold to H. M. Byllesby & Co. in 1912 he was retained and promoted to the position of accountant. A year later he was sent to Mankato as auditor of the Mankato division of the Northern States Power Co. and later acted as assistant to R. E. Brown, manager. He resigned in 1917 to become acting manager of the Northwest Utilities Co., formerly the Southern Minnesota Power Co. of Spring Valley. On the completion of the transmission line, connecting this division to the line extending from Winona to Chatfield, the plants in the Spring Valley division were closed and he returned to Mankato to assume the duties of general auditor of the company. Mr. McLean's previous public service and merchandising experience in the industry should prove of considerable value to the Electric Service Co.

Obituary.

JAMES HARDIE, head of the financial department of John Robertson & Co., Brooklyn, N. Y., manufacturers of hydraulic pumping equipment, died on Oct. 23, at his home, 154 Eighth avenue, Brooklyn. Mr. Hardie was 79 years of age.

WILLIAM D. WEAVER, formerly editor of *Electrical World*, died suddenly on Nov. 3, at his home at Charlottesville, Va. Mr. Weaver was born at Greensburg, Pa., Aug. 30, 1857. He was educated at Kentucky University and the U. S. Naval Academy, graduating in 1880 as a cadet-engineer. He also engaged in special laboratory work at the Sorbonne, Paris, France. He accompanied the first Greeley relief expedition in 1883. He resigned from the navy in 1892 to become editor of *Electrical World*, which he served continuously until his retirement to his country estate several years ago. Mr. Weaver served in the Spanish-American war as chief engineer of the *U.S.S. Glacier*. He was a member of the American Institute of Electrical Engineers and many other technical, scientific and civic societies and clubs.

For the Readjustment Period—What?

LVII.

Outlook for the Electrical Industries

Guy E. Tripp, chairman of the board of directors of the Westinghouse Electric & Manufacturing Co., on his return from Europe is quoted in the daily press as follows:

"Neither labor organizations nor capitalistic combinations can long resist the opinion of the majority. People as a whole are quick to determine which side is in the wrong in a situation of this kind. Their judgment has now crystallized to the point where radical union leaders can expect little sympathy.

"England has turned the corner in its labor difficulties because the people were beginning to feel the pinch and became tremendously tired of being imposed upon. They arose en masse to end the tie-up of the nation's transportation systems, the wealthy and titled volunteering their services along with the lowest classes.

"In this country the situation is additionally complicated by the fact that we have among us so many foreign-born who have not digested and are not in sympathy with the national institutions. Perhaps we shall have to deport some of these. At any rate, it is evident that the forces of law and order are near to victory and the present difficulties will be smoothed out along sound economic lines. Even Congress, which had a stop-watch held on it two years ago by the railroad brotherhoods, has come to the end of its patience.

"A period of depression following the inflation incident to the war appears inevitable, but this time seems likely to be postponed until the tremendous wastage and destruction of the last four years has been compensated for and the demands of normal business, which were thrust aside in favor of war work, have been satisfied.

"The output of electric current doubles every five years in this country. This ratio of increase has been maintained in the last half decade practically with no addition to equipment. This means that existing plants have been carrying a burdensome load, a condition which will be swiftly corrected now that manufacturing facilities are available for peace needs."

This statement, from a man who has had such unequalled opportunities for surveying the situation, should be encouraging to everyone engaged in the electrical industries.

C. A. TUPPER *President*
INTERNATIONAL TRADE PRESS, INC., CHICAGO

Financial News

The Stockholder's Responsibility.

Generally speaking, the theory is that a stockholder has no duty which he owes to the corporation. This is a colossal error and probably responsible for the disappointments which some investors have experienced in purchasing stocks in various corporations and then expecting that they could simply hire a number of men to run the business for them.

The problems of the corporation are equally the problems of the stockholder, for upon their solution is dependent, to a large extent, the earning power of the company and consequently the return to the stockholder upon his investment. Today the corporations of the United States are facing more serious problems than perhaps in any other period of their history. These relate to the basic principles of doing business and include both the relation of the company to government, and the relation of the company to its employes. There has been a tendency in too many cases on the part of government officials to ignore the interest of the stock holder; and the abnormal number of strikes that have taken place since the signing of the armistice is an indication of the unsettled conditions existing between employer and employe.

Cities Service Co. has been comparatively free from difficulties with government officials and with the employes of its various subsidiaries. Naturally because of its many public utility subsidiaries it has been required to go before commissions and other bodies for relief from intolerable economic conditions. It has had little or no complaint to make of the treatment it has been accorded by such bodies. This is due mostly to the policy of the management of the company which has been followed for many years, of concealing nothing from the commissions, telling its story to the public and of maintaining friendly relations with all with whom it does business.

However, the present trend of events cannot be ignored and everything in the power of the management is being done to maintain the friendly relations that have existed since its organization. Cities Service Co. is operated by Henry L. Doherty & Co., who manage and conduct the business of Cities Service Co. under a plan whereby their best interests lie in the fact that they are stockholders. It is to their interest to make the company the best success that they can. That is exactly the interest of the other stockholders in Cities Service Co. also. All of the problems that confront the Doherty organization are also the problems of the individual stockholder. The stockholders are partners of the Doherty organization in this matter, and everything that they can do for the company's advantage is not only well worth while, but exceedingly important.

Great Western Power Bonds Offered.

An issue of $2,000,000 Great Western Power Co. of California 6% first and refunding mortgage bonds, dated March 1, 1919, and due March 1, 1949, is being offered by Lee, Higginson & Co. at 96 and interest, to yield 6.30%.

The purpose of the issue is to finance the construction of a new hydroelectric generating plant of an initial capacity of 53,000 hp., which will increase the installed hydroelectric generating capacity of the company to 140,000 hp., and a new 100,000-volt steel tower transmission line from this plant to Valona, the distributing center for the San Francisco bay district. The company serves a population of 1,350,000, including San Francisco, Oakland, Berkeley, Sacramento and other towns, this population being nearly half that of the entire state of California.

The bonds are followed by $4,529,600 convertible debentures and by capital stock, which are stated to have an aggregate present market value of more than $15,000,000.

Pacific Gas & Electric Co. has declared a quarterly dividend of $1.50 on first and original preferred stock, payable Nov. 15

Chicago Pneumatic Tool Profits Show Improvement.

Chicago Pneumatic Tool Co. had its best quarter of the year in the three months ended Sept. 30, 1919. In that period there was earned approximately $2.42 a share on the 64,488 shares of stock outstanding. For the nine months ended Sept. 30, net income equaled about $7.06 a share on the stock or nearly the full year's 8 per cent dividend.

The company is gradually swinging into top production and its earnings are showing steady improvement. Each quarter this year has been better than the one preceding and the prospect is that the final three months of 1919 will eclipse the preceding quarters of the year from an earnings standpoint.

That the company's output is being increased is shown in the fact that as of Sept. 30 there was $4,878,812 in inventories, against only $3,648,734 on June 30. A large part of this inventory represents work in process and finished products.

Details of the earnings of the company in the last quarter and in the year to date are shown in the following income account covering the nine months ended Sept. 30 and the half year ended June 30:

	9 months ended Sept. 30.	6 months ended June 30.
Manufacturing profits before depreciation	$3,153,581	$1,819,226
Selling and administration expense	1,937,716	976,314
Net profits	$1,215,864	$ 842,912
Miscellaneous income.	15,572	10,283
Total income	$1,231,437	$ 853,195
Interest charges	166,278	112,498
Discount on bonds	78,532	52,355
Provision for taxes	135,000	120,000
Depreciation and renewals	268,192	166,152
Sinking fund	128,000	103,000
Net income	$ 455,434	$ 299,190

In the balance sheet it is interesting to note that the cash item and the investment abroad greatly decreased in the last three months, while bank loans have increased. At the same time, however, bonded debt has been decreased somewhat.

DAYTON POWER & LIGHT CO.
Report for

	September, 1919.	September, 1918.	Nine months ended September 30, 1919.	Nine months ended September 30, 1918.	Twelve months ended September 30, 1919.	Twelve months ended September 30, 1918.
Gross earnings	$219,728	$201,457	$2,043,279	$1,683,768	$2,790,240	$2,252,494
Operating expenses (including depreciation and taxes)	150,321	135,562	1,312,309	1,177,881	1,796,378	1,554,030
Net earnings	$ 69,407	$ 65,895	$ 730,970	$ 505,887	$ 993,862	$ 698,464
Non-operating revenue	3,058	2,822	26,615	23,636	36,280	26,482
Total income	$ 72,465	$ 68,717	$ 757,585	$ 529,523	$1,030,142	$ 724,946
Interest on bonds	$ 32,113	$ 32,192	$ 289,217	$ 256,935	$ 385,793	$ 302,298
Other deductions (including other interest and sinking fund)	19,037	12,197	120,048	106,048	160,652	139,031
Total deductions	$ 51,150	$ 44,389	$ 409,265	$ 362,983	$ 546,445	$ 441,329
Net income	$ 21,315	$ 24,328	$ 348,320	$ 166,540	$ 483,697	$ 283,617
Dividends on preferred stock	16,686	15,049	142,966	133,681	188,837	178,119
Surplus	$ 4,629	$ 9,279	$ 205,354	$ 32,859	$ 294,860	$ 105,498
Operating ratio	68.41%	67.29%	64.23%	69.95%	64.38%	68.99%

CITIES SERVICE CO.

	12 mos. ending Sept. 30, 1919.	12 mos. ending Sept. 30, 1918.	Month of Sept., 1919.	Month of Sept., 1918.
Gross earnings	$20,519,519.22	$21,973,480.12	$1,460,921.09	$1,907,155.26
Expenses	691,331.89	449,360.57	58,908.28	54,852.75
Net earnings	$19,828,187.33	$21,524,119.55	$1,402,012 81	$1,852,302.51
Interest on debentures	1,616,073.15	100,642.15	160,774.77	48,628.45
Net to stock	$18,212,114.18	$21,423,477.40	$1,241,238.04	$1,803,674 06
Dividends preferred stock	4,137,354.00	4,009,485.00	356,432.50	336,920.00
Net to common stock and reserves	$14,074,760.18	$17,413,992.40	$ 884,805.54	$1,466,754.06
Debenture fund			$ 859,196.61	
Contingent fund			553,484.68	
Stock surplus			1,607,720.74	
Surplus reserve			6,852,365.76	
Surplus			32,064,047.52	
Total surplus and reserve			$41,936,815.31	
Number of times preferred dividend was earned	4.40	5.34		
Per cent earned on average amount of common stock outstanding	44.52%	63.42%		
Preferred stock outstanding			$73,741,960.36	
In hands of public		$71,549,619.99		
Owned by company		2,192,340.37		
Common stock outstanding			$38,552,327.58	
In hands of public		$35,192,127.73		
Owned by company		3,360,199.85		
Series B 7% convertible debentures			$9,776,300.00	
In hands of public		$9,705,800.00		
Owned by company		70,500.00		
Series C 7% convertible debentures			$17,500,000.00	
In hands of public		$17,437,200.00		
Owned by company		62,800.00		